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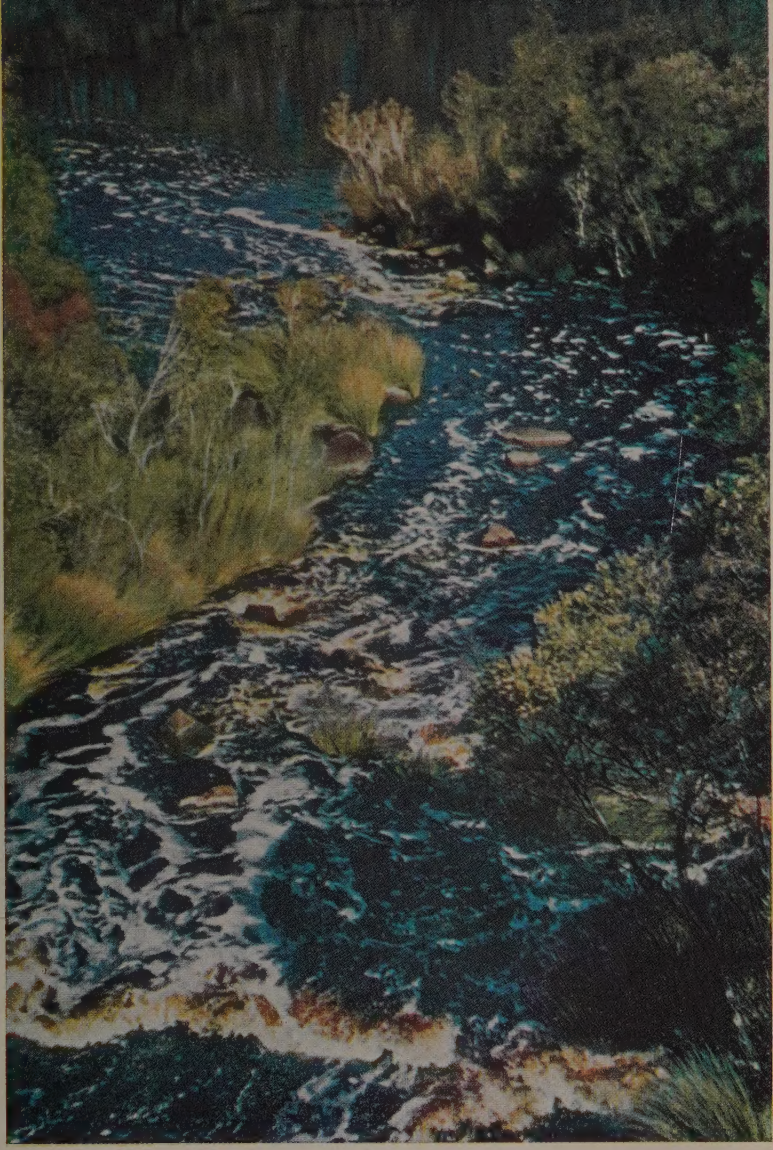

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WESTERN AUSTRALIA

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COVER PICTURE

Swollen by heavy winter rains, the usually placid Kalgan River presents this attractive picture of swirling white water as it traverses a stretch of rock-strewn shallows.

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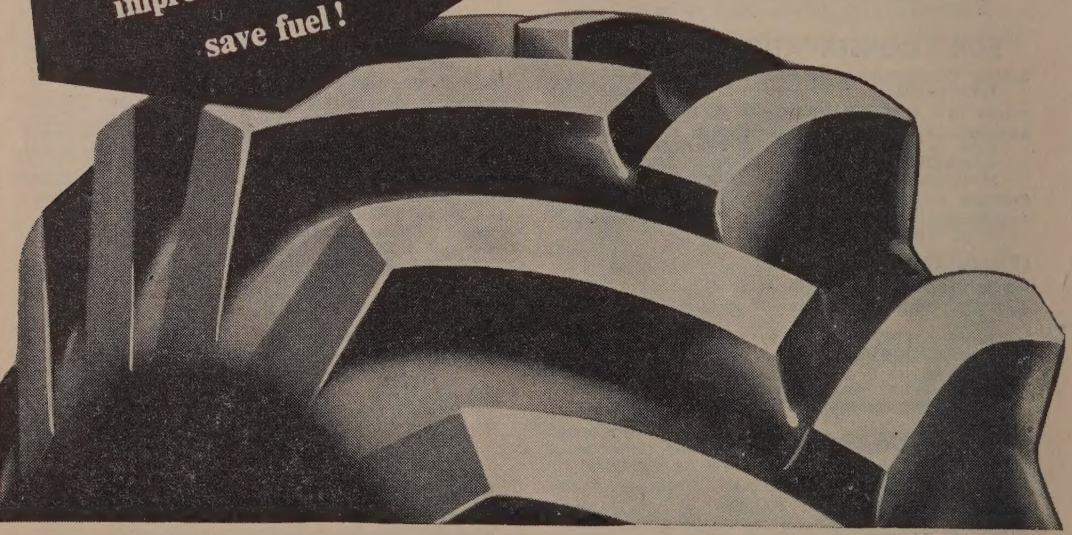

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INTERNAL PARASITES OF THE *Horse*

By J. SHILKIN, B.V. Sc., Senior Veterinary Surgeon

WHILE actual losses from internal parasites are not of common occurrence in horses, much unthriftiness, debility and colic can be attributed to their presence in the intestines, particularly in young animals.

Infection occurs through the horse swallowing the eggs or larvae which are present in the soil, water or grass. The different species then progress through their various life cycles ending with female worms laying eggs which are eventually passed out in the dung.

Although there are a large number of different species of worms which inhabit the intestine of the horse, only those few species which are considered of importance in Western Australia will be dealt with here.

REDWORMS

(Strongylus and Trichonema spp.)

Two different types of redworms are commonly found in horses. The large redworms (*Strongylus spp.*) vary in length from one to two inches and attach themselves to the gut wall by means of their mouths. The small redworms (*Trichonema spp.*) are about half an inch in length and lie free in the intestine.

Both types are usually reddish in colour and inhabit the large bowel and caecum (blind gut).

The life history of all these species is not completely known, but the eggs passed in the droppings will hatch in about 24 hours provided conditions are suitable. The larvae then undergo development and are ready to infest the horse in about a week. At this stage, due to an enveloping sheath, the larvae are capable of surviving for long periods on the grass, although the majority will die in about three months. When the pasture is wet with dew or rain they are able to climb up the blades of grass and are swallowed by the horse as it grazes.

Once inside the animals the course followed depends upon the species. In the case of *Strongylus spp.* the larvae apparently move through the body in various directions and have been found in the lungs, liver, spleen, pancreas, lymph glands and various blood vessels. Their later course is unknown, but they eventually return to the large bowel where they develop to maturity and eventually lay eggs, so continuing the life cycle. The development of the young worms in the horse may extend over a long period and it may be almost 12 months from the time the worm larvae were swallowed with grass before the worms are mature and laying eggs.

In the case of *Trichonema spp.* the larvae burrow into the wall of the large bowel, and remain there for some time, before returning to the bowel and developing to the adult stage.

Symptoms.

The condition induced by these worms is perhaps the most common and most serious parasitic disease affecting horses. The adults of *Strongylus spp.* feed on the intestinal wall and, as they are blood-sucking parasites, anaemia is a common

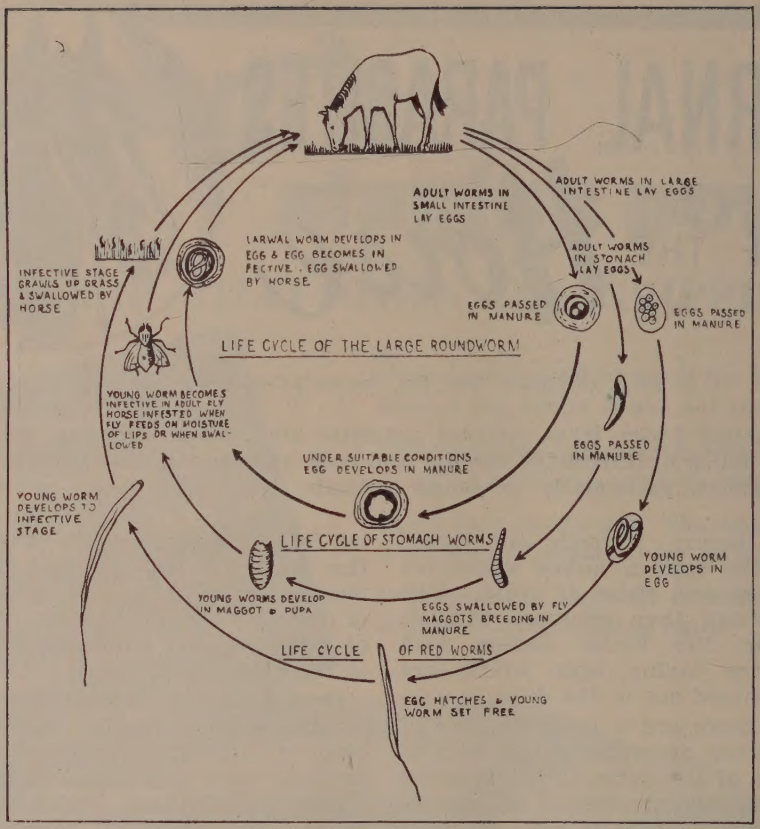
ADULT WORMS IN SMALL INTESTINE LAY EGGS
ADULT WORMS IN LARGE INTESTINE LAY EGGS
LARWAL WORM DEVELOPS IN EGG & EGG BECOMES IN FECTIVE . EGG SWALLOWED BY HORSE.
ADULT WORMS IN STOMACH LAY EGGS
INFECTIVE STAGE CRAWLS UP GRASS & SWALLOWED BY HORSE
EGGS PASSED IN MANURE
EGGS PASSED IN MANURE
LIFE CYCLE OF THE LARGE ROUNDWORM
YOUNG WORM BECOMES INFECTIVE IN ADULT FLY HORSE INFESTED WHEN FLY FEEDS ON MOISTURE OF LIPS OR WHEN SWALLOWED
EGGS PASSED IN MANURE
UNDER SUITABLE CONDITIONS EGG DEVELOPS IN MANURE
YOUNG WORM DEVELOPS TO INFECTIVE STAGE
LIFE CYCLE OF STOMACH WORMS
YOUNG WORM DEVELOPS IN EGG
YOUNG WORMS DEVELOP IN MAGGOT & PUPA
EGGS SWALLOWED BY FLY MAGGOTS BREEDING IN MANURE
LIFE CYCLE OF RED WORMS
EGG HATCHES & YOUNG WORM SET FREE

Fig. 1.—Diagram showing life-cycles of principal parasites.

symptom of the disease. The mucuous membranes of the eyes and gums become pale and the animal becomes very weak. In some cases, dropsical swellings may be seen along the abdomen. Injury to the wall of the intestine may pave the way for bacterial infection.

The larvae of the small species may cause the formation of nodules in the intestinal wall. These may give rise to digestive disturbances, resulting in soft and foul-smelling droppings, diarrhoea, and poor appetite. In advanced cases, the appetite may be depraved, causing the animals to eat bark, earth and rubbish. Outwardly the coat is rough, loss of condition is evident and the appearance generally dull and dejected.

One species invades the walls of certain arteries, particularly those supplying the large bowel and as a result of the invasion, the walls of the arteries becomes thickened and obstruct the flow of blood. It is believed that this obstruction may give rise to intermittent attacks of colic, but it should also be realised that such obstructions are frequently discovered in post mortem examinations of animals which have not suffered from colic at all.

Heavily infested horses do not perform well and many cases of thoroughbreds and trotters which fail to race according to expectation have shown remarkable improvement after treatment for worm parasites.

LARGE ROUNDWORMS
(Ascaris equorum.)

These are large yellowish-white worms up to 12 inches long usually found in the first half of the small intestine.

Eggs are passed out in the dung as with other species and under favourable conditions a larval worm is developed within

Fig. 2.—Redworms (Strongylus spp.) (natural size).

the egg in about 14 days. After being swallowed, the egg hatches in the intestine, the larva bores into the intestinal wall, reaches the blood vessels and is carried to the liver. It eventually reaches the lungs via the blood stream again, and after a period of development, migrates into the windpipe, crawls into the mouth, is swallowed, reaches the small intestine again and develops to the adult stage.

Symptoms.

These parasites are most serious in young animals, causing digestive troubles, enteritis, intermittent diarrhoea, colic, etc. In very heavy infestations portions of the bowel may be almost completely blocked, leading to rupture of the bowel wall.

Damage to the lung tissue resulting from the presence of the larvae may lead to pneumonia.

LARGE STOMACH WORMS
(Habronema spp.)

There are three species of these worms, varying in size from half to one inch in length.

Eggs containing minute larvae are deposited in the stomach and eventually passed out in the droppings. No further development occurs unless the eggs are swallowed by the maggots of certain species of flies, particularly the house fly, stable fly and bush fly. Once the maggot develops into the adult fly, the larval worms make their way into the proboscis (sucking organ) of the fly which in turn disgorges the larvae into saliva around the horse's lips. Many of the larvae are then swallowed by the horse. Upon reaching the stomach they then develop to the adult stage.

Symptoms.

Whilst Habronema infestation is very common in this country, it is not considered of any great economic importance. The smallest species is possibly the most serious as it burrows into the stomach wall, causing the formation of fibrous nodules and possibly causing digestive disturbances.

There is also an external form of Habronema infestation which may cause trouble when infested flies feed on sores or other

Fig. 3.—Redworms (Trichonemidae) (natural size).

Fig. 4.—The Large Roundworm (Ascaris equorum) (natural size).

moist places, such as the sheath, penis, or mucous membranes of the eye, etc. The larvae may be set free, and commence to burrow. Growths produced by the burrowing are difficult to heal and such growths on the eye, penis and sheath, particularly, are probably quite often confused with true cancerous growths. The condition frequently encountered in northern parts of Australia and commonly referred to as Swamp Cancer is most probably one of Habronema infestation.

SMALL STOMACH WORMS

(Trichostrongylus axei.)

These have not been reported in this State and, in any case, are not regarded as of any great importance.

PIN WORMS

(Oxyuris equi.)

These worms are commonly present in horses in this State. They vary in colour from white to grey or brown, and may be up to six inches in length including the long narrow tail. They occur in the large bowel.

The mature female worm deposits her eggs in clusters round the anus of the horse, but occasionally is passed out of the animal and lays the eggs in the droppings. A small larva develops inside the egg, which then hatches only after being swallowed. The larvae then develop to maturity in the large bowel.

Symptoms.

These are of importance mainly on account of the irritation produced round the anus by the female when depositing eggs. This itching causes animals to rub their tails against trees, walls, fences, etc.

TAPEWORMS

Three different species of tapeworms infest the horse, the smallest being from a quarter to two inches in length, the next two to three inches, whilst the largest and most common may measure up to 30

inches long and one inch wide. The smallest species has not been recorded in Western Australia.

They are generally found in the small intestine, but may inhabit the large intestine as well.

Whilst it is known that tapeworms generally require the assistance of an intermediate host such as an insect, mite or slug and that each type of tapeworm has its own specific host, the complete life cycle of these particular worms is not completely known.

It has been shown that microscopic oribated mites which live in pastures are the intermediate hosts of the tapeworms of horses.

Symptoms.

Even heavy infestations with these parasites are not regarded as of any great consequence in Australia. Reports from other countries have ascribed such symptoms as general unthriftiness, rough coat and digestive disorders to their presence, but in Australia at least, these symptoms are usually considered to be due to roundworm infestation.

BOTFLIES

(Gastrophilus spp.)

Three species of botflies, the common botfly, the throat botfly, and the nose botfly, are known to attack the horse, and all three species have been recorded in Western Australia.

The adults are two-winged insects, the common botfly being brownish grey with mottled wings and white face. The throat botfly is smaller and has a reddish thorax with a black band across the abdomen, and the nose botfly is smaller again.

The **common botfly** deposits her eggs on the hairs of the mane, chest, shoulders, and legs, mostly during the late summer and autumn. The eggs are yellowish in colour and are attached to the hairs for about one-third of their length. Though the eggs are ready to hatch in about seven days they may remain unhatched for months. Hatching only occurs when they are rubbed or licked by the horse.

The **throat botfly** deposits her eggs on the hairs under the jaws mainly during the late spring and early summer. They are fastened to the hairs for about two-thirds of their length, each egg being attached singly to one hair. Friction is not necessary for hatching to take place.

The **nose botfly** deposits her eggs on the hairs of the lips. The eggs are black and stalked and are aided in hatching by the moisture round the lips.

On hatching, the larvae of all species enter the mouth, bore their way beneath the mucous membranes of the mouth and tongue and eventually make their way to the stomach. Here they attach themselves to the wall by means of a pair of strong hooks on their mouth-parts. After a period of about eight to 12 months in the stomach they reach maturity and pass out in the dung. Once on the ground, the bots burrow into the soil for a short distance. In a few days the outer skin hardens to form a protective coat for the pupa developing inside. In from three to 10 weeks the adult fly emerges.

Effects.

The most important effects of botflies are those brought about by annoyance and worry at the time of egg-laying. In an attempt to prevent the flies from laying their eggs, horses will keep up constant movement and so obtain insufficient rest.

It is generally considered that the presence of the bots in the stomach even in large numbers does not exert any seriously

Fig. 5.—Large Stomach Worms (Habronema spp.) (natural size).

Fig. 6.—Pinworms (Oxyuris equi) (natural size).

harmful effect on the animal. It is possible that the mouth hooks may give rise to some inflammation where they are attached and that large numbers may act as an obstruction to the passage of food.

TREATMENT OF INTERNAL PARASITES

For the control of **Large and Small Redworms,** phenothiazine is the most efficient drug now available.

The phenothiazine powder is given in the feed in the following doses:—

	oz.
Draught horses	1
Light draught horses and saddle horses	¾-1
Yearlings and ponies	½

As phenothiazine in full doses may at times unaccountably cause ill effects, even death, the danger can be minimised by dividing the dose into three or four equal parts and giving one part daily for three or four days. Most horses will consume the treated food, particularly if a little molasses is added, and prior starvation is unnecessary. Bran mashes should be fed before, during and after treatment unless horses are on green feed and the bowels are free. The urine becomes a reddish colour when exposed to the air, and treated horses should be spelled until the colour of the urine returns to normal, usually in four or five days. Following treatment, horses should be run in a paddock which has carried no horses for a few months.

Phenothiazine can be used in a preventive way by giving horses 1 to 2 grammes per day in the feed or made up in a small quantity of molasses and bran or some other mixture which the horse likes and which may be licked from the hand or a spoon. The repeated small doses do not kill the adult worms but prevent egg laying almost entirely and also kill the developing worm larvae in the droppings. If this system is followed, contamination of pastures or stables is practically eliminated and horses will not acquire fresh infestations. Daily doses are desirable but once the horse has had about 15 or 20 consecutive doses, omission for a few days is of little consequence.

A new treatment has been recently developed against **Large Roundworms.** The new drugs are compounds of piperazine and those which have been used include piperazine adipate, piperazine hexahydrate (or hydrate), piperazine citrate, and a complex compound with the trade name "Safersan." All are very effective against **Large Roundworm, Pin Worm** and also against the **Small Strongyles.** For horses up to 12 months of age piperazine compounds are more useful than phenothiazine. They are, however, more expensive. These compounds may be given in the feed and while readily eaten by most horses are unpalatable to some. In these cases the drug can be given in a capsule, ball or drench.

The **Large Stomach Worm** is not often treated. As the smallest of the species is located in nodules in the stomach, treat-

ment is not effective. Carbon bisulphide is fairly effective in removing the other species, but as it can be dangerous in inexperienced hands and the method of administration is difficult, treatment of this nature is best carried out by a veterinarian.

Carbon tetrachloride may also be used and is given in a dose rate of 25 c.c. for every 500lb. weight in one to two pints of liquid paraffin. The animal should previously be starved for from 24 to 36 hours.

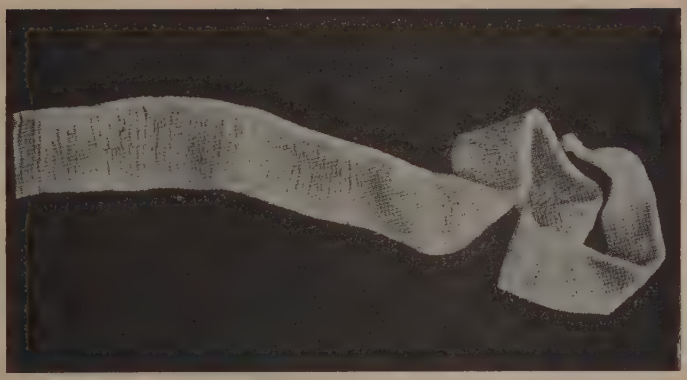

Fig. 7.—The large Tapeworm of the Horse (natural size).

Treated animals should be well fed subsequently until recovery is complete and the addition of two grains of iron sulphate daily will assist in relieving the anaemic condition induced by the worms.

A second treatment about three months later may be advisable in order to remove those worms which have been wandering through the body.

The **Pin Worm** is best treated with one of the piperazine compounds mentioned above. Dose rates vary with the different compounds, therefore, follow the directions given by the manufacturer.

As the egg clusters round the anus cause irritation they should be washed away with soap and water and then either mercuric or carbolic ointment applied.

The treatment of **Tapeworms** is not usually attempted.

The treatment of **Bots** is best carried out with carbon bisulphide at the rate of 6 c.c. for every 250 lb. weight, with a maximum of 24 c.c. This drug must be given either in a capsule or by stomach tube, but experience is required for both methods of treatment. The animals should be starved for from 18 to 24 hours prior to treatment and no food or water should be given for three or four hours after treatment. Treatment should be carried out about June when the majority of bots will have reached the stomach.

PREVENTION OF PARASITIC INFESTATION

Prevention is much more important in the control of parasitic diseases than medicinal treatment, as prevention measures thoroughly carried out will eliminate or at least reduce the necessity for medicinal treatment.

The chief source of infestation in most cases is the manure. Whilst it is difficult to prevent contamination of the pasture, wherever manure can be conveniently collected, such as from stables and yards, this should be carried out regularly. The disposal may present a problem, but it is possible to treat it so that flies are prevented from breeding in it. One method is to spread it out thinly on farm land so that drying occurs rapidly, and it ceases to become an ideal breeding-ground for flies. This method is, of course, not satisfactory in wet weather. Horses should not be run on land where this is carried out.

Fig. 8.—Bots (natural size).

Another method is to store it in compact heaps firmed down by beating the manure with shovels, and the outer layers of the heap should be turned into the centre of the heap at frequent intervals. The heat generated inside the heap kills any eggs or larvae that may be present.

Fig. 9.—Adult Botflies: Left, Common Botfly; centre, Throat Botfly; right, Nose Botfly.

Feed-boxes should be raised above the ground and hay should be fed in racks and not thrown on the ground.

Bedding should be changed frequently.

Clean water should be provided in troughs and where possible horses should not be permited to drink from shallow, stagnant pools.

Pastures should be spelled for at least three months, but whilst spelling from horses may be grazed by cattle or sheep.

Overstocking, of course, increases the contamination of pastures and should be avoided.

Adequate feeding plays a big part in reducing trouble from worm infestation, and it is common for animals to have relatively heavy infestations without showing any obvious symptoms so long as feeding and nutrition generally are good.

Small daily doses of phenothiazine as mentioned earlier will almost eliminate contamination of pastures and stables and are particularly valuable for mares in order to prevent infestations in the foals. Mares should have the daily dose, or at least the last three months of pregnancy, preferably throughout, and it should be carried on until weaning time.

DIAGNOSIS OF PARASITIC INFESTATION

Diagnosis is best carried out by examining the droppings microscopically to detect the presence of worm eggs. For this purpose the material must be reasonably fresh, preferably not more than a day old, when it is received at the laboratory.

Failing this, diagnosis must be based on the symptoms, and in some cases by the presence of adult worms which may be passed in the manure.

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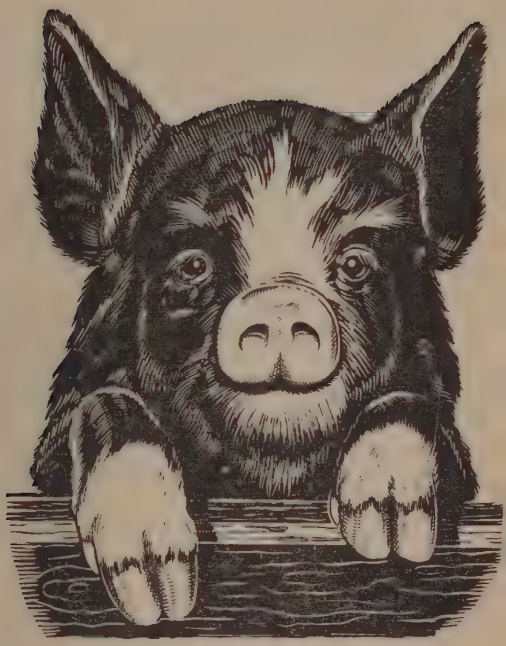
COUGHING PIGS

By P. M. A. HARWOOD, M.R.C.V.S.,
Senior Veterinary Surgeon



EVERY pig-farmer knows that excessive coughing in pigs is associated with unthriftiness, but most do not realise that a perfectly healthy pig does not cough. Dry feed or dusty conditions do not, as is popularly supposed, cause that frequent dry cough that is all too often heard in the pig sties.

An experiment in the United Kingdom was carried out with two groups of pigs. One group were removed from the sow by Caesarian operation and reared in a completely germ-free environment. The second group were better-than-average piglets collected from a commercial pig farm. Both groups of pigs were kept under identical conditions and given the same feed.

The germ-free pigs reached greater weights sooner and with less food consumption than the control group. They were never heard to cough. The control group although apparently perfectly healthy were heard to cough occasionally. On being killed, all the pigs in the control group showed small lesions in the lungs.

HIGH PERCENTAGE OF LUNG LESIONS

A survey carried out through Australian bacon factories revealed that up to 90% of the lungs of bacon pigs showed some lesions in them. The carcasses were of good quality but the importance of the lesions has been shown in the experiment described above. **Had these pigs not been affected they would have attained the same or greater weights with less food consumption, and would therefore have been more profitable.**

Research has shown that coughing in pigs is caused by invasion of the lung tissue with the virus responsible for infectious pneumonia. The lung tissues and air passages are damaged by the virus, allowing them to be attacked by bacteria which invade the tissues and set up inflammation.

When unfavourable weather, bad housing, poor nutrition or a change of environment lower the pig's resistance, invasion with the virus results in pneumonia. A high fever develops and the pig becomes ill. It develops a racking cough, pants for breath and refuses to feed. Death may occur, but in many cases the pig recovers from the fever. However the damage to the lungs persists. Often they become ad-

herent to the walls of the chest. Such pigs are quite uneconomical to keep as they will eat more than their value in food before attaining a marketable weight. However, the purpose of this article is to consider those pigs which become only mildly affected. Apart from a cough and a varying degree of unthriftiness these pigs are never acutely ill **but they eat away the pig-producer's profits by growing less quickly than they should.**

HOW IS PNEUMONIA VIRUS SPREAD?

1. Practically every pig which has lesions in its lungs (which means almost the whole pig population) is a carrier of infection.

2. Carrier sows often infect their piglets early in life.

3. The common roundworm of pigs passes through the lung tissues during development. The coughing in young pigs associated with worms is due to infection carried by the worms. Pigs which were experimentally dosed with very large amounts of sterile (germ-free) worm larvae did not develop any sign of cough during the migratory stage. The livers, however, were severely damaged. The action of worm larvae in the lun[illegible] probably twofold—

(a) mechanical transmissic on the worm larva;

(b) interference with the predisposing to inv virus.

4. Pigs which have been a in life and are subsequently breeding stock are often carri petuate infection.

HOW CAN THE VIR ELIMINATED?

Treatment with drugs do virus. It is only effective a teria which follow the virus thine and penicillin are ve valuable in treating pneum their use will not eradic Coughing in pigs can be c tention to the following d

1. By a careful selec stock. Any breeder, so coughs should be rejecte healthy it appears other

2. Good housing. Warm, dry sleeping-places and clean runs assist the pigs to overcome infection. The less the original infection, the smaller the risk of subsequent active carriers.

3. Clean hygienic pens mean fewer sources of infection.

4. Good feeding. A high intake of protein and an adequate amount of Vitamin A in the form of greenstuff or shark liver oil, mean a high level of resistance to infection.

5. Control of Worms. By strict control of worms the risk of virus being carried to the lungs will be reduced. Naturally, control of roundworms will also benefit the general health of the pigs, as these parasites are capable of inflicting severe damage to the liver and intestines and are an important cause of unthriftiness in their own right. Treatment with sodium fluoride controls mature worms present in the bowel. A new drug called piperazine, now on the market in more than one proprietary remedy, is very effective and also exerts some control on the immature worms.

6. Quarantine measures. All new purchases should be quarantined and any that cough should be isolated and if neces-

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Fencing along a watercourse, as illustrated here, does not interfere with cultivation and contour systems. Such fences prevent stock from crossing the gully and may permit more efficient use of water supplies.

FARM PLANNING

A New Technique

By B. a'B. MARSH, B.Sc. (Agric.), Soil Conservation Adviser

A NEW method for planning farm subdivision is described. Control and prevention of soil erosion, including the use of contour methods where needed, will be made easier on farms planned in this way. Often also, the farm road system will be better placed to give year-round access around the farm, gate sites are better, and usefulness of present watering places increased. The method is based on fencing along natural obstacles to cultivation, on the need to fence areas requiring different grazing management, and on the need to stabilise natural drainage lines.

That fences have indirectly caused erosion has long been realised by farmers and conservationists alike, and a demand for advice on farm planning is developing.

Soil conservationists the world over have developed techniques of farm planning suited to their agriculture. Most of these methods have been based on techniques used in the United States of America.

A common feature of all planning techniques has been the long time needed to collect all the data considered relevant.

We have examined other methods in relation to the planning of Western Australia wheatbelt farms and have developed a method of planning which cuts down so much on time spent collecting data, that memory can be used very effectively and thus makes detailed mapping even less necessary.

The method evolved has been used on many farms in the sheep and cereal areas as far apart as Dalwallinu, Wickepin, Toodyay and Narembeen. The method is certainly workable and it produces a farm plan which also looks workable and efficient.

The technique has been developed to be suitable for properties which run stock in conjunction with cereal growing. It is based on the importance of fencing correctly and stabilisation of the natural drainage system. So far the technique has been developed for use where the type of

cropping is not diversified and classification of the soil or land use seems unimportant where fencing is concerned. It is felt that some attempt will have to be made in some intensively farmed areas, to modify the technique. It may be necessary to class land according to its best commercial use.

The technique can be discussed under several headings.

LAND USE

Many farm planning methods base the fence layout on the varying need for soil erosion control practices. It is considered here that fences need not separate eroded and non-eroded areas. Fences are used to control and confine stock and for this reason fence positions in some cases are determined by the need for grazing control. It is usually suggested that seepage areas carrying green fodder during the summer months be fenced from the general farm, similarly with salty areas and poorer sandy country, whether arable or non-arable.

TOPOGRAPHY

To a soil conservationist it is obvious that the topography of the farm must be taken into account when designing various aspects of a farm layout. A contour map will show the topography very well, and perhaps many soil conservationists reasoned along these lines in developing farm planning techniques. There are however two other ways of understanding the topography.

(1) A map of the creeks and depressions, rocky ridges and hills.

(2) The farm itself is a full scale three dimensional model which can be seen easily and memorised. Contour mapping is discarded because of time factor.

The two other methods are used in the following manner:—

(1) The natural features are mapped, using the old fencing as a mapping grid; or using an air photo.

(2) The adviser drives completely over the farm and remains on the farm while compiling the plan with the help of the farmer.

Because land use mapping and contour mapping are eliminated it is possible to compile a plan while in continuous consultation with the farmer, **in one day.**

NATURAL CULTIVATION BOUNDARIES

A method of determining fence lines which it seems, has not been used by other farm planners, was developed in the Western Australian technique. The countryside is naturally divided by numerous obstacles to cultivation such as creeks, gullies and un-eroded depressions (which should never be cultivated) by rocky ridges and by surveyed roads and boundaries. The division of the landscape is further complicated to an unreasonable extent by fences placed without regard to the lie of the land. If many of the fences were placed alongside the natural boundaries, then most of them would be out of the way and cause no **extra** erosion hazard. Forming a basic fence plan which can be subdivided according to certain basic principles simplifies planning and erosion control. As each soil erosion problem is usually confined within natural obstacles there is seldom a need for taking contour banks through fences. As water supplies are commonly near watercourses this system of fencing makes for efficient use of water supplies.

SUBDIVISION OF THE NATURAL CULTIVATION AREAS

Placing fences along natural boundaries leaves areas which are clear for cultivation and these areas have been termed natural cultivation areas. Usually these require subdivision and this involves a certain amount of compromise between certain requirements.

These are—

(1) Economy of fencing.

(2) Convenience of access.

(3) Water in each paddock, to eliminate damaging movement of stock through gates.

(4) Economy in water reticulation.

(5) Convenience in cultivation.

(6) Safety of tracks, firebreaks, and cultivation.

(7) Soil erosion control needed.

(8) Paddock size.

(9) Movement of stock from remote paddocks.

All these have to be considered in relation to the farmers own attitude towards erosion control practices. This in turn is governed by his methods of farming, machinery available, the seriousness of the problem, and finance.

With these considerations in mind the fences subdividing natural cultivation areas are placed where possible in order of priority,

(a) Along ridges and across saddles.

(b) At right angles to the contour down a hillside.

(c) Along a contour or graded contour line.

(d) A combination of these.

Fences so placed do not interfere greatly with contour cultivation. They allow safe disposal of water from formed roads (see Journal Agric. W.A. March-April, 1954, p. 203, or leaflet No. 2133). They allow safe ploughing of firebreaks (see Journal of Agric. W.A. September-October, 1955, p. 585, or leaflet No. 2291).

Formed roads along ridges and directly up and down hill are fairly direct and safe whereas contour roads can be inconventiently long and tortuous and collect water. Fence lines usually are, and should be the site for farm tracks, as this helps to keep cultivation areas as clear and as large as possible. As each fence has a logical reason for its placement it is easy to site without taking measurements.

THE TECHNIQUE

A map is drawn of the property on a 20 chain per inch scale. Existing fence lines are marked, these being used as a mapping grid. Where no fences exist, more conventional methods of mapping or air photos may have to be used.

A slow trip is made around the farm with the farmer driving. Everything pertaining to water runoff and erosion is noticed, mapped and discussed with the farmer. Erosion control methods are tentatively decided upon, and mapped.

All natural features which are or should be cultivation boundaries, are mapped and discussed. The need for leaving hollows grassed to withstand erosion is stressed. Eroded tracks and firebreaks are pointed out and methods of control discussed. Also discussed where pertinent, is the necessity for fencing off areas requiring regulated grazing and these are mapped. All water supplies are mapped and in sections of the farm where water is obviously scarce, the possibilities for developing water supplies and for reticulating water are discussed. Help can be given in locating possible earthtank sites and catchment banks and drains.

When the mapping is completed a copy is made of the details without marking in any of the existing fences except those which definitely must not, or cannot, be moved.

The first planning stage involves marking fence lines along probably suitable natural boundaries and around areas requiring regulated grazing such as salt country. Some of these fence lines are deleted later if not wanted. This procedure leaves areas of good land which are clear for cultivation and can be called natural cultivation areas. These areas are subdivided as mentioned previously under the heading "Subdivision of Natural Cultivation Areas." To aid in arriving at a reasonable average paddock size, the farmer's ideas about paddock size are sought. Next to the map a reference square is drawn equal in size to the acreage decided upon. An attempt is made to divide the natural cultivation areas up into paddocks about that size. Smaller paddocks are of course useful near the homestead, and larger ones may be more convenient in the far corners of the farm.

This stage in the planning is difficult and requires the specialist knowledge of the conservationist to be carefully fused with the farmer's more intimate knowledge of his farm.

If it is decided that a contour fence may be more desirable in a particular part (this is not often the case) it may be necessary to drive out to that part of the farm in order to take a rough sight with the dumpy or Abbney level to determine an approximate position. For the sake of brevity many of the finer points have not been discussed here.

When most fence lines have been determined, if all points have been considered, the plan should show main access tracks to all paddocks and around the farm.

All soil erosion control work should be marked roughly.

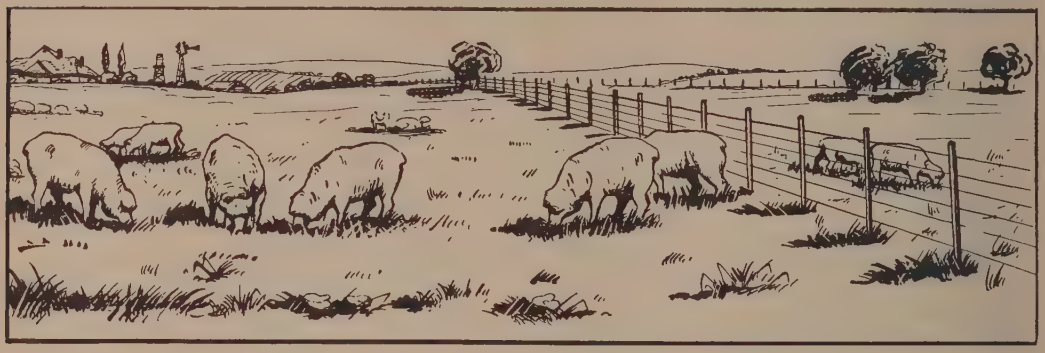
Follow up visits may be necessary to assist with problems associated with water conservation and erosion control.

THE FUTURE

The writer feels that the next two decades will see great advances in population size and in agricultural techniques brought about by nuclear power and cheap fertilisers (particularly nitrogen). The trend would be towards intensive farming with more cultivation.

Such a change will be more easily negotiated on farms where contour practices can be adopted easily and efficiently and where subdivision can proceed logically.

Farm plans adopted using the described technique seem to be very compatible with contour practices and can be further subdivided on a logical basis.



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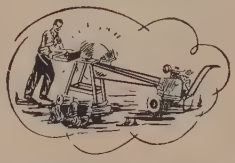

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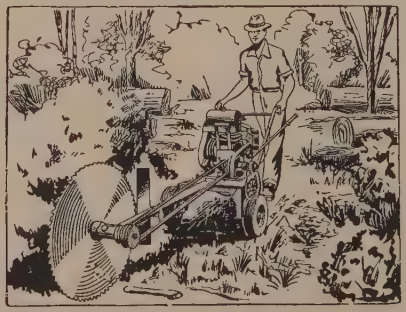

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URINARY CALCULI OF SHEEP IN WESTERN AUSTRALIA

By H. W. BENNETTS, D.V.Sc., Principal, Animal Health and Nutrition Laboratory

URINARY calculi or "stones," according to reports received by the Department of Agriculture during recent years, appear to be one of the most important causes of deaths in wethers and rams in the more eastern agricultural districts.

An investigation of this problem was commenced towards the end of 1949 with object of determining:

(a) The types of calculi affecting sheep in these areas.

(b) The causes and mode of formation of the calculi.

(c) Means of preventing the resultant losses from urinary obstruction, or "water belly," in rams and wethers.

The initial step was a survey of the region referred to in order to obtain information defining the problem, and to arrange for the co-operation of sheep owners in experimental work. It was found that the calculi commonly occurring were those composed principally of silica. In consequence our investigations, which are continuing in the field and the laboratory, have been concerned particularly with the causation of siliceous calculi.

Losses from urinary calculi, however, are by no means restricted to the region referred to, nor to this one type of calculus, and the purpose of this article is to give a general account of the problem with particular reference to local conditions. This account is based on published information from elsewhere, much of which was reviewed by Beveridge (1942), and on data collected in this State. The problem, however, is still very incompletely understood and no satisfactory means of control are yet available.

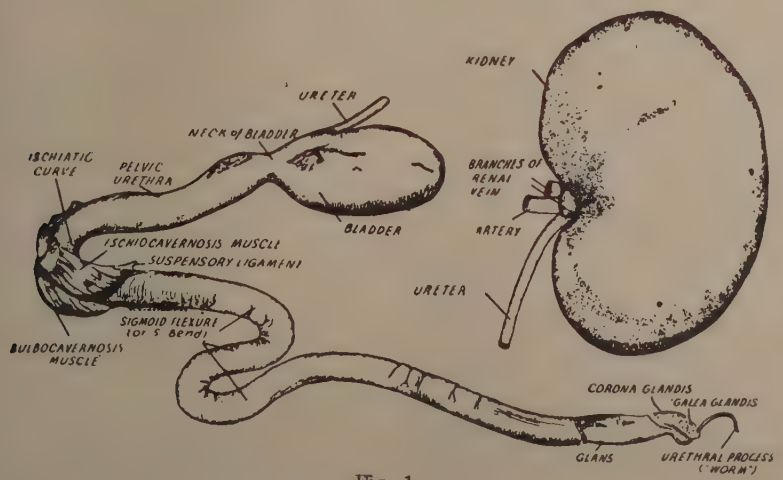

Fig 1.

Fig. 1.—Semi-diagramatic sketch of the urinary tract of a male sheep

A GENERAL ACCOUNT OF URINARY CALCULI

1. Occurrence.

Urinary calculi have been reported from many countries. In England and America they are found most frequently in sheep being hand fed on a rich diet for show or for the market. In South Africa and Australia they are common in arid areas with a dry hot climate.

Reference will be made, later, to the circumstances of occurrence in this State.

2. Symptoms.

The presence of calculi in the kidney or bladder is not recognised until they pass on to cause partial or complete obstruction of the urinary tract, usually of the urethra (the passage conveying urine from the bladder to the exterior). In consequence their presence is not recognised in the ewe during life, as the larger more dilatable female passage permits of the animal passing them. In the male, particularly the wether, however, blockage of the narrow urethra is likely to occur at the urethral process, the sigmoid flexure or the ischiatic curve (see Fig. 1).

The first symptom is restlessness and occasional straining to urinate. The wool around the pizzle is nearly always wet and may be encrusted with salts. Later there is evidence of pain, the gait is straddled and the back arched. The bladder becomes distended with urine and ruptures within 48 hours of the stoppage. This is followed by distension of the abdomen and death within 24 hours to several days. In some cases the obstruction passes on before rupture of the bladder occurs in which case recovery is spontaneous, although the condition may recur due to the presence of further calculi.

3. Post Mortem Appearances.

Following rupture of the bladder the body cavity contains a large quantity of blood-stained fluid. The bladder and urethra are inflamed. The obstruction calculi may be found in the sites mentioned. They may also be seen in the bladder, kidneys or sometimes in ureters (see Figs. 4, 5 and 6). The kidneys may be enlarged and the pelvis dilated, or may be small and shrunken due to chronic inflammation.

4. Causes.

The more commonly reported calculi in sheep consist either of phosphates or of calcium carbonate (carbonate of lime). Among the factors considered to contribute to their formation are the following:—

Fig. 2.—Calculus lodged in the lumen of the urethral process (worm) of a ram
(Journal of Agricultural Research.)

(a) Vitamin A Deficiency.—When the vitamin is deficient certain changes occur in the lining membranes of the kidney and other parts of the urinary tract, leading to the formation of debris which may act as a focus for the accumulation of salts (e.g. phosphates and carbonates) present in the urine.

(b) Imbalance of Calcium and Phosphorus.—It has been found that when the diet contains a great excess of calcium over phosphorus or vice versa the occurrence of calculi is favoured, particularly if Vitamin A is deficient.

Cereal grains and bran contain a gross excess of phosphorus over calcium, whereas with lucerne and clovers the reverse is the case. There is some evidence also that the amount of magnesium ingested may be a factor.

(c) Mineralised Drinking Water.—It has been suggested that this may play a part, although the evidence is not very strong. It is possible, however, that waters containing high concentrations of calcium or magnesium might have the effect of balancing or unbalancing the mineral content of the diet and thus tend either to control or favour the occurrence of calculi.

(d) Concentration of Urine.—A great reduction in the volume of urine may occur during hot dry weather, on a dry hay or concentrated diet, or with lack of water.

This concentrated urine is infrequently voided and, particularly, if the feed is rich in mineral salts these tend to deposit and form calculi.

(e) Bacterial Infection.—Bacterial infection of the urinary tract is frequently found in cases of calculus but this may be the result and not a contributing cause of the condition.

Fig. 3.—Typical attitude of a wether showing pronounced symptoms of calculi
(Journal of Agricultural Research.)

5. Prevention and Treatment.

It is obvious that prevention must depend primarily on a knowledge of the particular factors contributing to the occurrence of the calculi, and the correction or modification of these factors.

Treatment is generally unsatisfactory. If the blockage is in the urethral process the calculus can sometimes be removed, or the process may be amputated. If the blockage is higher up the calculus can sometimes be massaged outwards. Even if the immediate obstruction is removed, however, recurrences are apt to follow.

With certain types of calculi, changing the reaction of the urine by administration of acid-forming medicines (or by starvation) is sometimes effective in dissolving calculi and, if continued, in preventing their formation.

URINARY CALCULI IN WESTERN AUSTRALIA

As indicated earlier the occurrence of calculi has been reported widely in this State but the condition appears to constitute a serious economic problem only in the Eastern Districts and in the "clover belt" where "clover stone" has caused the death of many valuable rams.

1. The Eastern Agricultural Districts.

During recent years losses of up to 10 per cent. of rams have been commonly experienced; in wethers the mortality appears to be higher. The following deaths were reported from five widely spaced properties in 1949:—30 out of 90, 41 out of 90, 50 out of 150, 50 out of 250, and 50 out of 500 wethers. The first four sets of figures refer to Merino weaners. A number of sheep owners have discontinued holding wethers beyond the age of about six months because of the heavy mortality experienced even during their first summer and autumn.

Losses commence generally towards the end of the dry period, from March onwards and continue after the advent of green feed until June or July. In dry years deaths may commence earlier and cease later. Long dry seasons appear to favour the incidence of the condition; this was particularly heavy in 1949 when, moreover, losses were spread throughout the year.

Young animals, notably weaners, and two-tooths, appear most susceptible, but this susceptibility may be more apparent than real as it is a common practice in these areas for wethers and stud rams to be disposed of at an early age, so that only a small number of older males remain on the property.

It is evident that sheep maintained in good condition and heavily hand fed during the dry period are much more likely to be affected than those which are less well fed. Feeding on stubbles, unstripped oats, and with oat grain supplements from February or March until the advent of green feed is a fairly general practice throughout.

Few sheep other than Merinos are carried in this region so that we have no evidence regarding breed susceptibility. Southdowns however, are known to be affected. The evidence to date indicates that serious losses are associated with heavy grey or red calcareous soils, under arid conditions. Only sporadic cases have been reported from similar soil types in

"Lake Country" where sheep get a green picking throughout the dry period; or on lighter soil types.

With regard to water supply, information so far available suggests that this is, generally, not an important factor. It is, however, one which cannot be dismissed from consideration, and which will be investigated.

The Type of Calculus Causing Obstruction.

A large number of calculi, obtained from affected sheep throughout the agricultural areas, have been received and examined at the laboratory. These have been of two types (a) Calcium carbonate calculi and (b) Siliceous calculi.

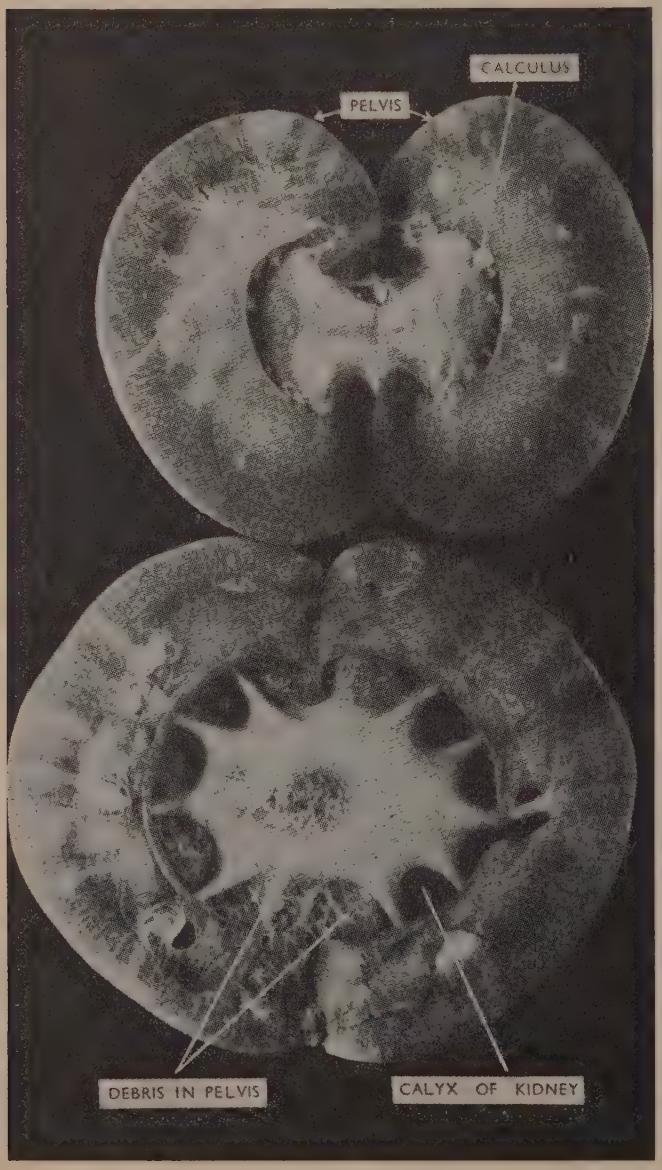

Fig. 4.—Debris in pelvis of kidneys—An early stage in calculus formation (American Journal of Veterinary Research)

Either type may cause obstruction and both may be encountered on the same property. It seems evident, however, that the siliceous calculi are much more common and are the main cause of economic loss in the agricultural areas.

Our investigations, which are continuing intensively, are therefore concerned with this type of calculus.

(a) Calcium Carbonate Calculi.—These are of the size and shape of small shot with a smooth polished "metallic" surface. They are hard in consistency and, commonly, greyish in colour. The colour, however, varies; in one instance gilded stones were found. They are found in the bladder and commonly cause obstruction of the uretha. On analyses these calculi are found to consist largely of calcium carbonate (carbonate of lime).

(b) Siliceous Calculi.—These are quite different in appearance. They are commonly of the size and shape of a grain of wheat but may be larger and may be irregular "chips." They have a rough uneven surface are whitish in colour on the surface, and are friable or easily powdered. These calculi are apparently formed in the kidney and are found in the pelvis of that organ, giving an appearance like that in Fig. 4. They have been commonly

encountered in the kidneys of ration sheep on one property where, remarkably, urinary obstruction has not been encountered in the wethers or stud rams. Few farmers appear to have observed these calculi in the kidney but it is believed that they must be fairly commonly present for it is evident that obstruction of the urethra commonly results from siliceous calculi; one ram breeder reported that he has frequently found them blocking the ureter in rams dying from urinary obstruction, in which case they are obviously derived from the kidney.

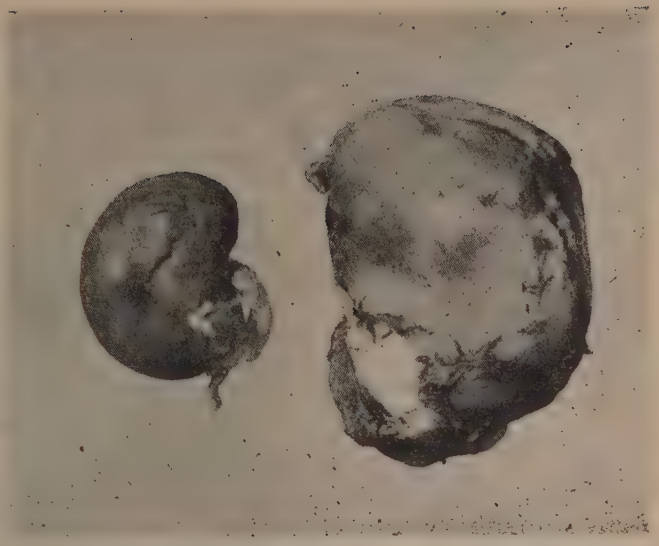

Fig. 5.—On right, a hypertrophied kidney containing a clover stone. The kidney on left is smaller than normal size (atrophied) (By courtesy of H. T. Carroll)

On analysis these calculi are found to be composed largely of silica, an inert substance which is present in large amounts in the soil (e.g. sand grains are composed largely of silica) and in many plants, notably in hay. It is known that the urine of herbivorous animals, as a result of their diet, may contain relatively large amounts of silica. Siliceous calculi, however, have not been described as of common occurrence in sheep except in parts of the United States of America and in this State. Little is known of the mechanism of their formation.

More recent observations have confirmed the fact that sheep maintained under normal grazing conditions in our agricultural areas excrete large amounts of silica daily in the urine, whether on green or on dry feed. In consequence the urine, voided in small volume while sheep are on dry feed, is highly charged with silica. It seems, therefore, that under these conditions, only slight or transient alterations in urine composition could result in precipitation of the silica, leading to calculus formation.

We have no evidence that any of the other factors referred to earlier contribute to the formation of siliceous calculi.

On the other hand the occurrence of calcium carbonate calculi may be related to one or more of these factors, or also to the consumption of plants containing a high oxalic acid content.

2. Urinary Obstruction on Parakeelia.

Since 1925 we have received not infrequent reports of mortalities in wethers from ruptured bladder occurring when Parakeelia composed the dominant or only grazing available to sheep, notably in certain seasons in the Murchison and Goldfields Districts.

It is only recently, however, that we have found that the urethral obstruction in these cases is due to the presence of calcium carbonate calculi, identical with the type described above.

It appears possible that the calculi may be formed under these circumstances on account of the demonstrably high oxalic acid content of the plant, Talapatra *et al* (1948) having shown that the consumption of excessive quantities of this acid by cattle may lead to high urinary excretion of alkaline carbonates. It is possible also that the plant may irritate the urinary tract thus contributing to the deposition and concentration of the calcium carbonate. Further evidence is required on these aspects.

3. Calculi Associated with Subterranean Clover—"Clover Stone."

Very early in the investigation of infertility of sheep grazing dominant sub-

terranean clover pastures* we recognised that the presence of an unusual type of calculus in the kidneys of sheep was a common occurrence on clover properties. Some investigation of this condition was also carried out, but only passing reference has so far been made to it, the first detailed published description being that of Carroll (1949).

The calculi are formed in the substance of the kidney where small yellow, granules can be seen. These collect in the pelvis as "sand" which commonly aggregates to form a stone which becomes moulded into the shape of the pelvis and calyces of the organ. The calculus material is sulphur yellow in colour and the calculi are yellow throughout. They are moist, soft and very friable, being easily broken up. They vary in size from grains of sand to very large stones up to three ounces in weight, when the kidney substance is, not uncommonly, reduced to a shell surrounding the calculus (see Fig. 6). The kidneys may be enlarged and hypertrophied, or small and shrunken.

It is remarkable that despite extensive damage to one, or even both kidneys, ewes may be in good condition and in apparent good health. Wethers and rams, however, may show the usual symptoms of urinary calculus described earlier, yellow encrustations being common around the pizzle. Carroll has noted deaths in rams from urinary obstruction.

The calculi have been analysed in this laboratory and found to differ in chemical composition from any of the calculi reported in literature. The mineral content is extremely low, the total ash content being below 2 per cent.; the nitrogen content is very high.

The exact nature and mode of formation of these calculi has yet to be determined, but there seems no doubt that extensive grazing of subterranean clover (*Trifolium subterranean* var. Dwalganup) is primarily responsible for their formation. It seems probable that they are composed principally of inflammatory exudates resulting from an irritant substance in the plant, the colour being due to pigments derived also from the clover. In that connection a rusty staining of wool around the urinary orifices is common in clover-grazed sheep. It would appear that the prevention of "clover stone," as of infertility, must be based on measures designed to prevent sheep from regularly eating excessive amounts of subterranean clover. Detailed recommendations for the control of "clover disease" have been given by Shier and Rossiter (1949).

Fig. 6.—A yellow clover stone (top) which weighed approximately 3 oz. and is a perfect cast of the lumen of the hypertrophied kidney (below) from which it was removed

(By courtesy of H. T. Carroll)

* See this Journal (1947), 23:1.

4. Control.

In the present state of our knowledge there are no measures which can be recommended for the prevention of urinary calculi in sheep.

As regards siliceous calculi it appears probable that an increase in daily output of urine during the dry feed period would have a beneficial effect. There are, however, no known practicable means of achieving this end, at least in this environment.

The investigation of the problem is being continued in the hope that further knowledge may lead to the finding of some means of prevention.

SUMMARY

(a) Present knowledge of the occurrence, signs, and possible causes of urinary calculi in sheep is briefly reviewed.

(b) Our present very incomplete knowledge of this condition in Western Australia is presented and discussed in relation to findings elsewhere.

(c) Urinary calculi, and the resultant urinary obstruction, are known to be the source of serious economic losses in the Eastern Agricultural Districts. Siliceous calculi have been found to be the type principally responsible; the investigation of this problem is being continued.

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ACKNOWLEDGMENTS

We are indebted to many sheep owners for their co-operation and interest and to Mr. H. T. Carroll for the loan of prints from which Figs. 5 and 6 were prepared.

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Owing to the rising costs of raw materials and labour, it has been found necessary to increase the prices of the binding covers and filing cases for "The Journal of Agriculture". The prices, until further notice will be as follows:—

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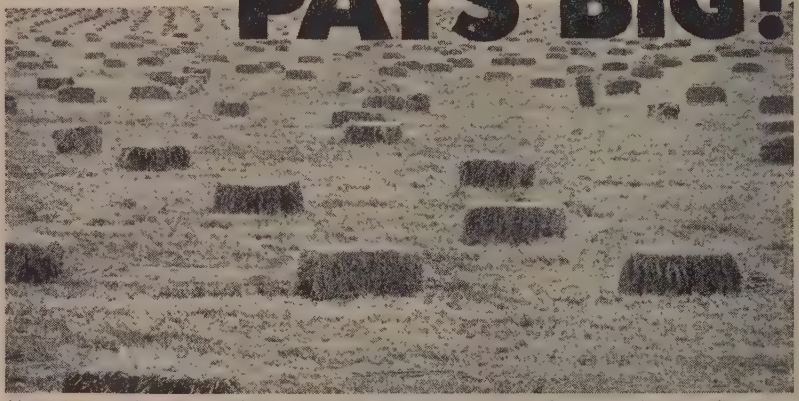

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PASPALUM GRASS

(Paspalum Dilatatum Poiret)

By C. A. GARDNER, Government Botanist, and H. G. ELLIOTT, Assistant Superintendent of Dairying

ORIGINALLY native to Uruguay and Argentina, Paspalum dilatatum was introduced into the U.S.A. about the middle of the 19th century and is now firmly established and cultivated in the Gulf States where it is known as "Dallis grass" after A. T. Dallis of La Grange, Georgia. It was introduced into Australia by Baron von Mueller about 1880 and since 1898 its cultivation has steadily increased.

Of the six species of *Paspalum* recorded from Western Australia *Paspalum dilatatum* is the one most commonly cultivated. Two of the species are native to this State, the other four being introduced.

The name *Paspalum* is from the Greek *paspalos*—millet; the specific name *dilatatum* refers to the dilated rhachis of the raceme. The plant has many vernacular names such as Paspalum Grass, Large Water Grass, Golden Crown Grass and others.

In the irrigation areas of Western Australia, paspalum is spreading naturally, and many farmers have permanent pastures consisting mainly of this grass, usually in association with legumes such as subterranean, white and strawberry clovers or lotus major, and often with other grasses such as ryegrass and cocksfoot.

BOTANICAL DESCRIPTION

A perennial grass with tufted ascending or erect culms, leafy at the base, 2-5ft. high, glabrous except the inflorescence. Inflorescence consisting of 3-7 spike-like spreading racemes 2-4in. in length, towards the summit of the culm, the spikelets arranged in three or four rows along a flattened rhachis. Spikelets 1-flowered. Lower glume absent. Upper glume ovate-orbicular, shortly acute. Three-five nerved, pubescent on the back, the margins ciliate with silky hairs, with the addition of long hairs at the base of the spikelet. Lower (sterile) lemma like the upper glume in shape and texture, but smaller and usually glabrous, 3-nerved. Fertile lemma shorter than the upper glume and sterile lemma, almost white, crustaceous orbicular, almost flat, with closely inrolled margins embracing the margins of the palea, faintly 3-nerved, almost smooth and shining, but minutely rugose under a lens. The fertile lemma and the tightly embraced palea, enclosing the grain, readily fall from the spikelet, and are together called the "seed" in commercial terminology.

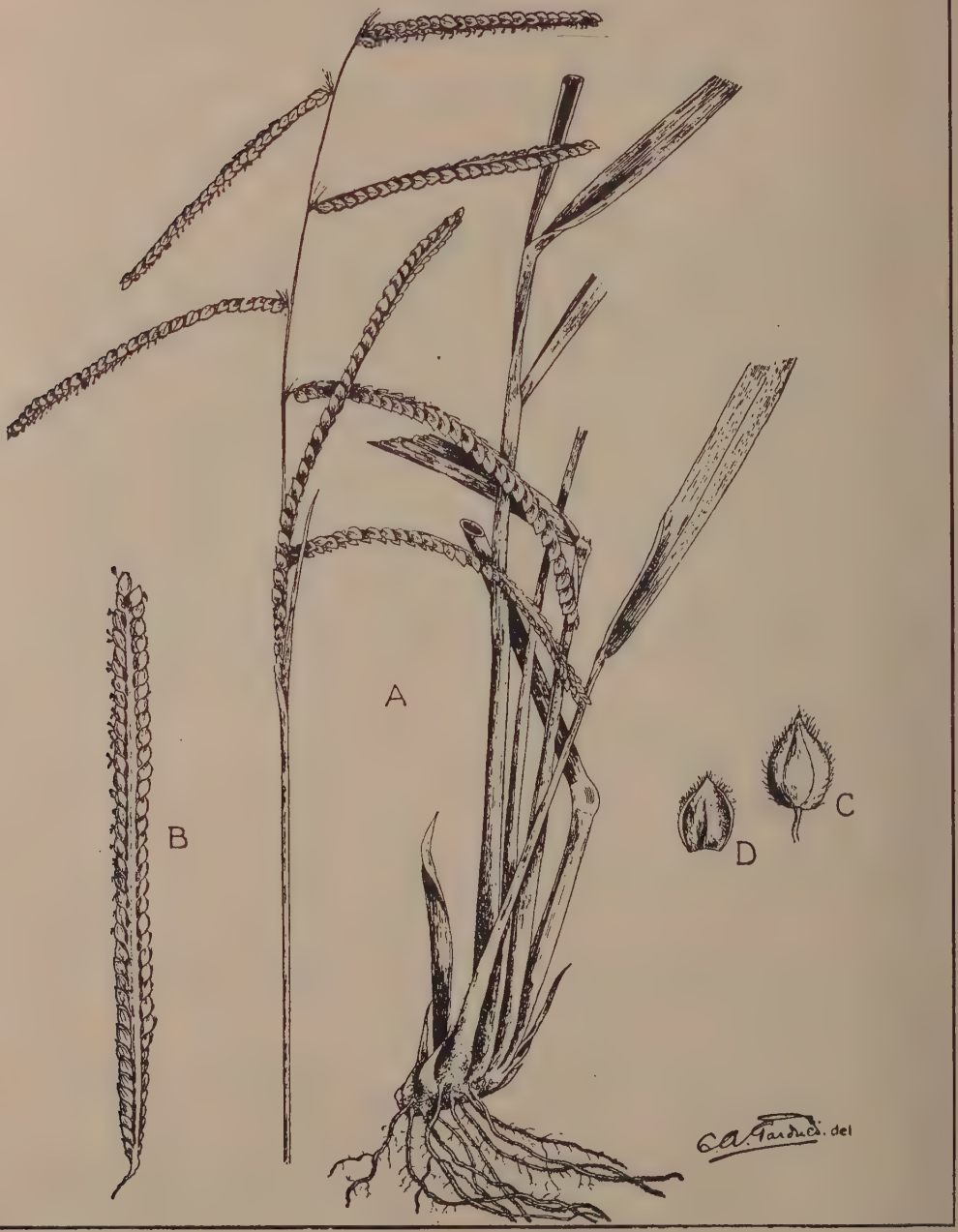
SOIL REQUIREMENTS

Paspalum dilatatum does not appear to favour any particular soil type and will grow on light sandy soil or stiff clays where ample moisture is available. As usual, with plants of this kind, the best growth is obtained on moist, rich alluvial flats, or under irrigated conditions. It may be sown with success in any moist situations, even on hillsides in the Lower South-West.

TIME OF PLANTING

To obtain the most satisfactory results from seed, planting should be carried out in the early autumn or late spring months, unless the land can be irrigated, when early to late summer planting can be carried out.

Germination of the seed is most rapid when the soil temperatures are high and the ground moist. Partial or total failures



PASPALUM GRASS.
Paspalum dilatatum Poiret.

A—Portion of plant; B—Spike; C and D—Details of spikelet.

often occur if planting is carried out in the early winter months when the land is cold and wet.

METHOD OF PLANTING

The ground should be well worked and have a fine seed bed. The seed is sown at the rate of 10 to 12 lb. to the acre when sown alone, but it is usually sown at 4 lb. to 8 lb. to the acre with white clover (2 lb.) strawberry clover (½ to 1½ lb.), subterranean clover (4 lb.) or ryegrass (4 lb.).

Superphosphate at the rate of 2 cwts. per acre is recommended, but under irrigated conditions, up to 4 cwts. per acre can be used to advantage.

After sowing, the seed should be lightly covered with soil by using a T-Bar roller, bush or light harrows. Deep planting must be avoided at all times.

AFTER-CARE

Paspalum makes vigorous growth from October to May inclusive and under ideal conditions the most rapid growth occurs during January, February and March. It has a tendency to run to seed rapidly during these hot months however and should be grazed heavily and mown to prevent the seed stems from forming.

To prevent the grass from becoming sod-bound, it is necessary to apply a system of efficient renovation so that clovers and other grasses can grow in association with it. Normally, this renovation should be done in the autumn and two to three years after establishment.

On old sod-bound paspalum swards, complete breaking-up and working down of the area is recommended. After a good tilth is produced, the area should be reseeded with perennial ryegrass at 4 lb. to the acre and white clover at 2 lb., or midseason subterranean clover at 4 lb., per acre. Under irrigated conditions a mixture of perennial ryegrass (6 lb.), cocksfoot (4 lb.), white clover (2 lb.), and strawberry clover (½ lb.) is recommended.

ERGOT

For many years, paspalum in this State has been seriously affected with ergot (*Claviceps paspali*), a fungus which attacks the seeds and which may produce poisoning.

The presence of ergot is noticed when the seed-heads form, as affected seed-heads become sticky.

To control the disease and guard against stock poisoning, seeding should be prevented by mowing or grazing heavily during the hot summer months.

SEED

Paspalum normally produces seed freely but as the seed ripens from the tip of the head downward and shatters off as soon as it is ripe, good germinable seed can only be gathered by hand. During recent years, the quality of seed available has been particularly good and the percentage of germination has been highly satisfactory. The number of seeds per lb. is estimated at 320,000 with a bushel weight of 20 lb.

FEEDING QUALITY

Practically all classes of livestock will appreciate paspalum when it is young and vigorous, and it remains succulent and nutritious when managed and grazed efficiently.

When not grazed adequately in the early summer, it runs to seed and the stalks become fibrous and tough.

EFFECT OF FROSTS

Paspalum is a heat-loving grass and is susceptible to frosts. Even light frost will cause it to turn brown, but with the advent of warmer weather in the spring, it will resume growth and produce a large bulk of good feed, provided that ample moisture is available.

PROS AND CONS

From the foregoing, it will be seen that paspalum has definite advantages as well as certain disadvantages and these have been summarised below.

Advantages.

(1) It is a perennial grass which makes vigorous summer growth.

(2) It thrives on moist soils but is highly drought-resistant.

(3) It will stand heavy grazing by stock.

(4) It gives green feed in the spring, summer and autumn months.

(5) Seed will remain dormant in the ground for months until conditions are favourable for germination.

Disadvantages.

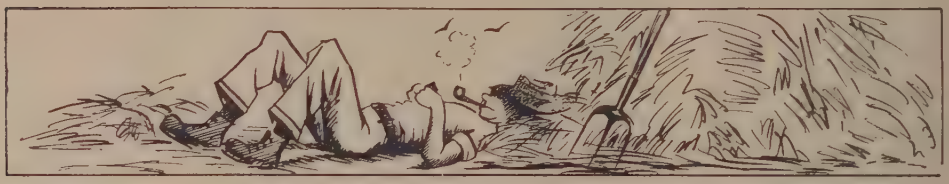
(1) It is susceptible to ergot.

(2) It is not palatable when allowed to become rank or old.

(3) It may become troublesome under irrigated conditions if not well managed and controlled.

(4) It will not stand severe frosts.

(5) The seed matures unevenly causing low germination rates.



Book Review.

TEXTBOOK OF MEAT INSPECTION

ALTHOUGH Australian flocks and herds have been kept free from many of the diseases which are endemic in older countries, the importance of an efficient meat inspection service cannot be over-emphasised. Our per capita consumption of meat and meat products has always been high and in view of the close relationship between animal health and public health it is essential that our meat inspection standards should be maintained at a high level.

In 1936, Mr. J. Drabble, B.V.Sc., published a textbook on meat inspection which has become a standard work on this subject. The fact that it has recently achieved its sixth edition is evidence that it has met the need for an authoritative textbook on meat inspection suited to Australian conditions.

As a lecturer, demonstrator and co-examiner in meat inspection at the Veterinary School of the University of Sydney and as a former Officer-in-Charge of Meat Inspection at the N.S.W. State Abattoirs, Mr. Drabble is well qualified to write on this important subject.

His book is based on the course of lectures given by the author at the Sydney Technical College and consists of a section dealing with elementary anatomy and physiology followed by chapters on slaughtering and dressing methods; a history of meat inspection; notes on the preservation of meat and lengthy and well-illustrated chapters on the various diseases of livestock.

Glossaries of trade and technical terms and a comprehensive index add to the value of the book as a work of reference.

It is a book that will be especially valuable to the student of meat inspection methods and one that will interest many stock-owners. It contains 110 excellent illustrations, and 414 pages of well-presented information.

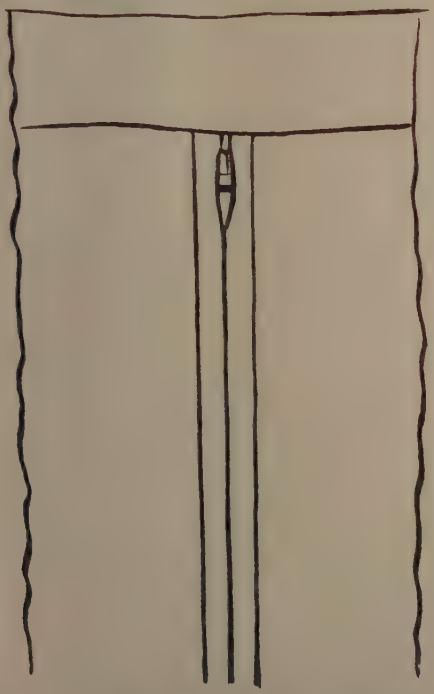
"Textbook of Meat Inspection" is by J. Drabble and is published by Angus & Robertson. Price £4 4s.—J.M.

ATTACHING ZIP FASTENERS

By BRENDA CLEEVE

ZIP fasteners have now almost replaced all other types of fastener for plackets. Not only are they easier and quicker to attach but they give a neater result with less effort.

Of the many possible methods of attaching zips or slide fasteners, the two most commonly used are perhaps the simplest to do. For either of these methods the two edges of the placket opening should be turned under on the exact seam line and tacked carefully. Special care should be taken at this stage as these two edges are usually on a cross grain and can be stretched easily, resulting in a bulky finish.



Method 1, in which the zip is centred under the seam.

Before tacking a zip in position check that the turnings on either side of the opening are wide enough to enable them to be caught under with the row of machining. Where they are very narrow a facing may need to be put on first. The second method described below requires a wider turning on the front edges. Where the turn under is small on both sides the first method of attachment will be found to be more satisfactory.

An alternative to this step is to sew the seams up, leaving no opening at all. When the zip has been attached, the part of the seam over it can then be unpicked so that the zip can be opened and closed. This method requires extra care in tacking the zip into place as a very uneven result can be obtained when the seam is undone and the zip has slipped while being machined. The disadvantage in using this method is that the garment cannot be fitted to check the placement of the zip before machining

—unless another seam is left undone and this is not always easy when making a frock.

To fasten a zip in position place the opening, with edges tacked under, flat on the table or over a sleeve-board and insert a flat book, pad or piece of cardboard between the layers of the garment. With this simple aid the zip can be pinned and tacked in place without moving it from the table and without pinning the garment together completely. Avoid placing a zip in position with the garment held over your hand as it is very easy to get a buckled result. Pins should be inserted at right angles to the zip rather than along it as this can stretch the edges also.

Before attaching the zip, check the length of it with that of the opening. A large space at either end of a zip gives a very ugly finish especially on a fitted garment as these will gape just as a break in a seam.

Method 1.

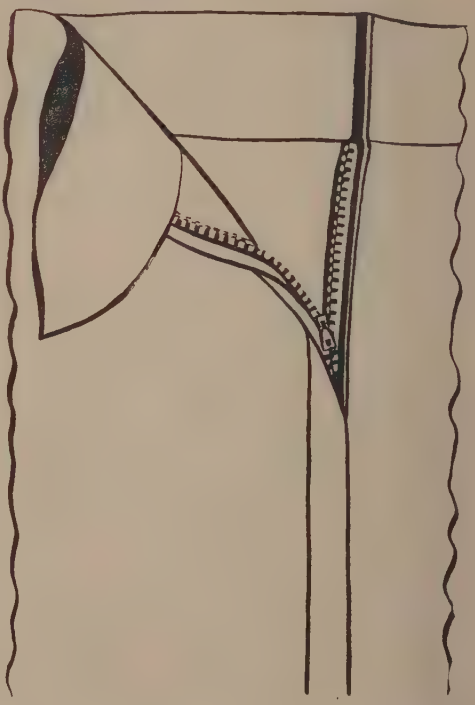
In this method the zip is fastened evenly under both edges of the opening so that the metal section is covered.

Place the fastener in position and pin one edge of the opening into place with the edges covering half of the metal. The other edge is then placed so that its edges meet those of the other side of the opening and thus conceal the metal section of the zip.

For a skirt opening, commence machining at the top of the zip. On a dress start about 2in. from the top so that these stitches can be overlapped after machining completely around the zip. If the dress has a belt, the neatest finish is obtained by commencing on the seam joining the bodice and the skirt, so that the overlapped stitches will be covered by the belt.

Machine an even distance on each side of the opening being careful not to stitch over the metal. For the best results sew close to the edge of the metal leaving just enough room for the zip tab to be moved up and down without cutting the cotton each time.

Leave the zip closed while it is being stitched into place except when machining around the top where the metal tab lies. With most zips this will be wider than the remainder of the zip and is sometimes quite bulky. To allow for this, and to enable the tab to lie flat, the stitching may need to be fanned out around the top end. When about 2in from the top end of the zip, finish stitching with the needle still in the material. By raising the foot it should be possible to slide the tab section down 2 to 3 inches so that the machine can be guided smoothly around this end. When this section has been sewn, slide the tab back to its closed position to complete the sewing of the fastener.



Method 2, in which the zip is placed off centre and covered by the front section only.

On soft material or fabrics which slip easily out of place, it may be easier and more satisfactory to catch the two edges of the opening together with oversewing stitches to hold them in place. They can be removed as soon as the fastener has been machined into place.

Method 2.

The fastener is attached unevenly in this method and is completely covered by the front section of the opening.

Place the zip in position as above and commence by pinning and tacking the back at right hand edge in position so that it just meets the edge of the metal.

The front section is placed so that its edges meet those of the back section and in this way it covers the metal of the fastener.

To attach to zip, machine along the right hand edge as close to the edge as possible. On the front section it is necessary to machine about ¼in. from the edge of the material to avoid the metal slide. The distance from the edge for this row of stitching should be ascertained while placing the zip in position, and when tacking, a guiding line can be made. By stitching this way, a tuck is formed to cover the fastener.

Most people will find that it is easier to obtain a neat result with the latter method.

NEATENING THE ZIP

To avoid the cloth backing of the zip curling up during washing, fasten this to the seam edges where possible by hemming or slip-stitching to the seams on the wrong side. If the seams are wide enough, do this all around the zip. Where they are not, attach firmly at the centre or waist seam at both ends.

ZIPPER ATTACHMENTS

Attachments for the purpose of fastening zips can be obtained for most modern sewing machines. These usually have one side of the foot cut away so that the needle can be placed right on the edge of the metal if desired. One type of attachment has a sliding arm which enables the needle to be placed on the right or left of the zip as required.

These attachments are also designed for stitching of pipings and are especially useful in making of soft furnishings such as loose covers, cushions and bedspreads.

SNACKS WITH POTATOES

JACKET-BAKED potatoes can form the basis of tasty meals without a meat dish. They lend themselves to many combinations of flavours to tempt the appetite on numerous occasions.

To bake potatoes choose tubers of the same size. Scrub them and prick with a fork and place on the oven slide, in a moderate oven. Medium sized potatoes take about 45 minutes to one hour to cook. Do not use a covered dish such as a casserole as the steam formed in cooking makes the potatoes heavy and sodden.

To serve potatoes plain, cut a deep cross in the vegetable and squeeze from beneath in a clean cloth so that the flesh is forced through the cut. Sprinkle with salt and pepper, add a piece of butter and a sprig of parsley.

For variety try some of these ideas to make a more complete meal. The quantity given is for each medium-sized potato.

(1) Scoop out the filling of the potato, mash up with a beaten egg, seasoning and a little chopped parsley. Refill the potato cases and bake for 5 to 10 minutes.

(2) Add 1-2 tablespoonfuls grated cheese to the above filling. If too rich the egg can be omitted. Extra grated cheese may be sprinkled on top.

(3) Add 2 teaspoonfuls of finely grated or chopped onion to the potato pulp.

(4) Mash the pulp with 1 dessertspoonful butter, 1 teaspoonful carraway seeds and 1 teaspoonful chopped parsley.

(5) Add 2 tablespoonfuls chopped grilled bacon or ham.

(6) To the ham mixture add 2 teaspoonfuls grated onion and a pinch of nutmeg.

(7) Use 2 tablespoonfuls flaked smoked fish (already cooked), 1 teaspoonful parsley and 1 dessertspoonful of chopped or minced onion.

For richer fillings use cream instead of milk for mashing pulp.

A NEW IDEA FOR A KNITTING OR EMBROIDERY BAG

By BRENDA CLEEVE

AN apron-bag combination is a new idea for the ardent knitter or needlewoman and can save the time usually wasted in searching for lost scissors or retrieving wandering balls of wool.

The apron ties around the waist and rms an apron-cum-bag in which spare ool, needles, book or embroidery can be rried. On the front a triangular pocket rms a holder for wool and scissors and ttons being used. When you have nished your work, slip off the apron, ace your work inside the bag and roll it o until next required. The apron ties are ed to fasten the bag to keep your work cure.

To make the bag you will need 20in. of material 36in. wide. Colourful cotton or silk scraps make an attractive bag.

Open out the material to its full width and cut off a strip 36in. by 4in. to form the waist ties. From the shorter edge cut a piece 4in. by 16in. for the front band of the apron.

This should leave a piece of material 32in. by 16in. and this is now folded over to make a square 16in. by 16in. On the

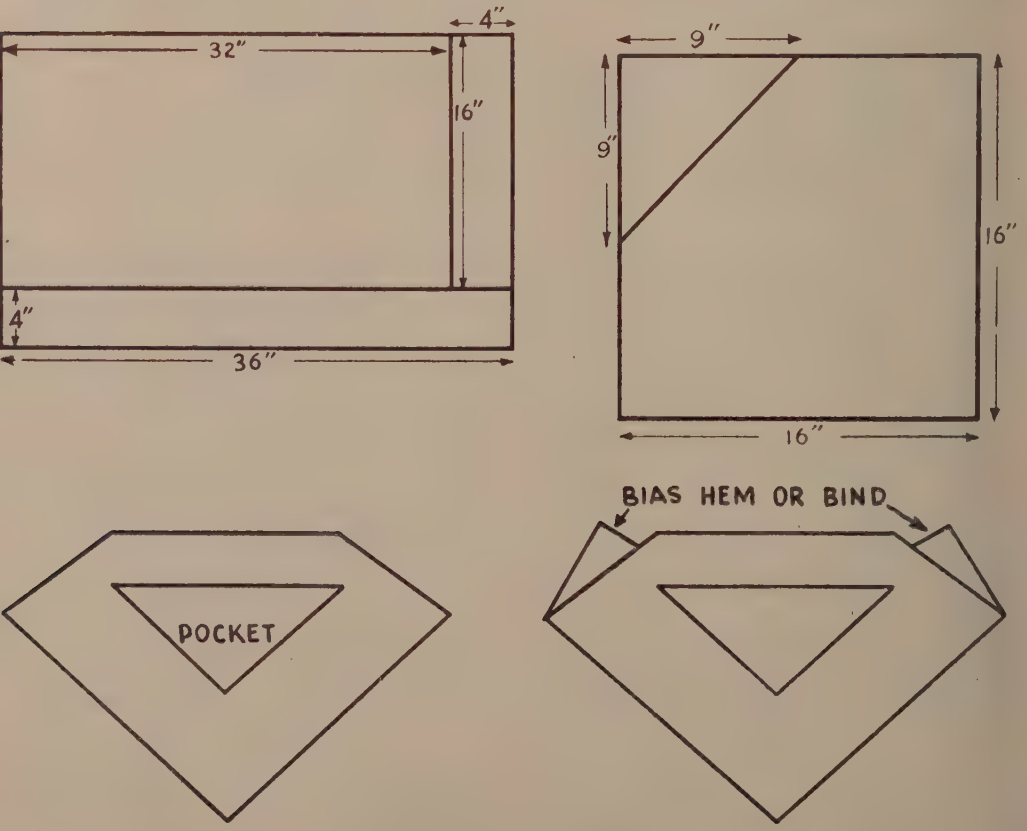


Fig. 1.—How to cut out the apron.

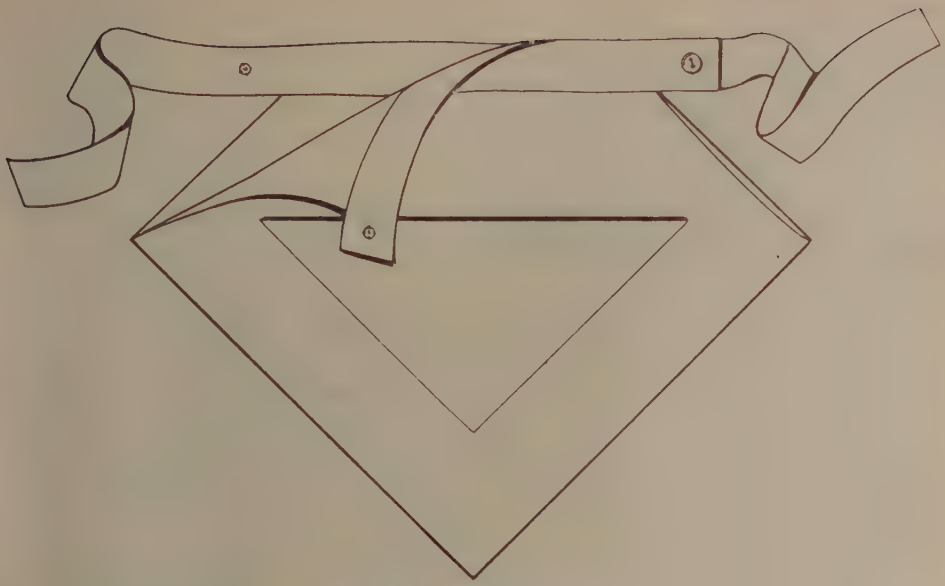


Fig. 2.—The completed apron.

folded edge and at one end measure down 9in. Join the 9in. marks to make a diagonal line. Cut off the triangular corner piece thus formed and this piece, opened out, is the front pocket section.

To make up the apron, take the body section and cut through the fold so that the back and front are separated. Turn a hem on the longest side of the pocket section. On the remaining sides turn a single fold. Place the pocket in position on one of the body pieces to form the front and machine into place.

The front and back sections are joined together on the two long sides leaving the shorter sides and the waist section open. The shorter sides should be finished off with bias binding or with a small hem, carrying the finish across the back and front pieces.

The shortest strip cut first should be doubled over to form a band. This is joined to the front waist section. It will be found that this band is too long for the front waist so leave an overlap of 1½-2in. at each end.

Use the long strip to make the back waist band, placing it evenly on the waist line so that the free ends form the apron ties.

Fasten the front band to the back band by means of buttons and buttonholes (or press studs) so that the front piece can be let down to enable work to be put into the band.

PEG APRON

This same idea can also be used to make a peg bag and washing apron. In this case a firmer type of material should be used for the body of the apron. Hessian or duck could be used for this section and a softer material for the ties and bands.

A bib attached to the waist-band is a good idea on a washing apron, too.

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BERKHEYA THISTLE

(Berkheya rigida (Thunb) Bol and W. Dod.)

There is little doubt that this perennial thistle, native to South Africa, was introduced to Western Australia in ballast from timber boats using the Hamelin Jetty near Augusta. It was first recorded in 1909 and a spraying programme during the last two years has reduced it to small proportions.

WEEDS of Western Australia

By **G.R.W. MEADLY** M.Sc.
Officer in Charge, Weeds and Seeds Branch

BERKHEYA THISTLE

(Berkheya rigida (Thunb.) Bol. and W. Dod.)

THE first official record of Berkheya or Hamelin thistle in Western Australia was in 1909. A specimen in the State Herbarium bears this date along with the vague locality of "near Bunbury." With little doubt it was gathered from the Hamelin Bay area in the vicinity of Cape Leeuwin. Ships carrying timber to South Africa used the Hamelin jetty during the early years of this century and the introduction of Berkheya thistle from that country, its native habitat, was associated with this timber trade. As the ships arrived in ballast, which was dumped before loading commenced, roots or seed probably arrived by this means.

By 1954, trading with Hamelin had long since ceased and much of the jetty had disappeared but the thistle had found conditions to its liking and spread over about 50 acres of coastal country. It had extended along the Karridale road to the fringes of the karri formation where the soil improves to a sandy loam. In Victoria it was recorded from Geelong in 1906, Coode Island in 1908 and Port Phillip in 1909. More recently it appeared in South Australia.

During the past ten years Hamelin Bay has become increasingly popular as a fishing and holiday site thus increasing the risk of distributing the thistle to agricultural districts. Systematic control measures were commenced in 1953 and a big reduction of the infestation has resulted although the need for treating seedlings from dormant seeds continues.

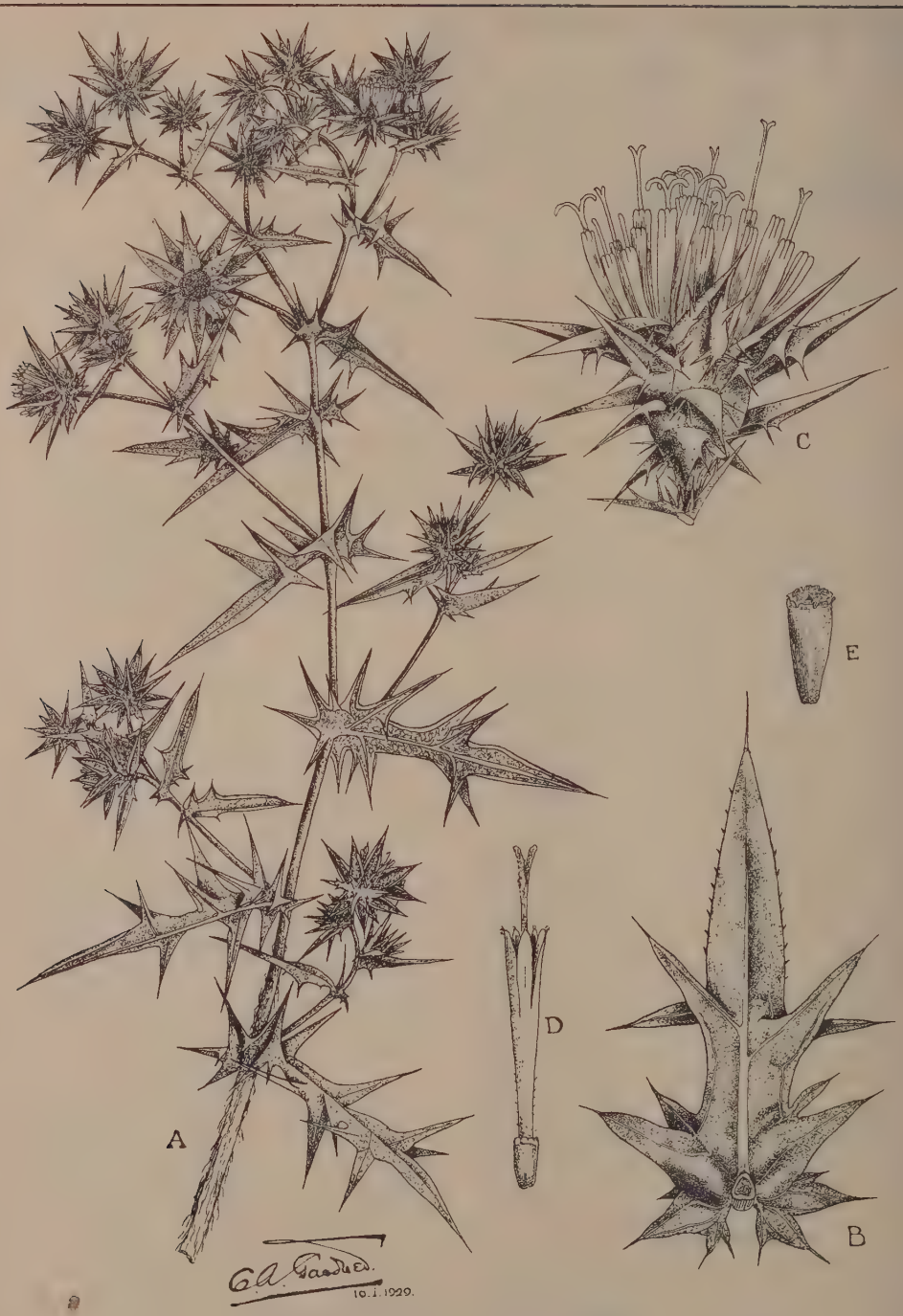
DESCRIPTION

This plant is one of the many weed species belonging to the thistle group. The generic name, Berkheya, is used to differentiate it from other species while the alternative, Hamelin, refers to the locality in which it grows.

It is a herbaceous perennial of one to two feet in height with glaucous leaves two to four inches long, deeply cut and with spiny lobes. The plants have a tendency to develop shoots from rhizomes. The heads of yellow flowers are small compared with those of spear and saffron thistle and are borne on short stalks. The bracts surrounding the flowers are concave and sharply pointed with paired small spines towards the base. The smooth, glabrous achene, about one tenth inch long, has at its apex a pappus of sort scales, sometimes fused together. The silky pappus characteristic of many thistles does not occur.

SIGNIFICANCE

In Western Australia, Berkheya thistle has always been restricted to an area of relatively useless coastal sand and, in the main, has been a potential rather than an actual problem. It has a number of characteristics, however, that could make it a very undesirable weed—a creeping perennial habit, the production of a large number of seeds, spiny and unpalatable foliage and a seed head adapted for mechanical distribution. Although the spread during the last forty years was



BERKHEYA THISTLE (Berkheya rigida)
A—Branch; B—Leaf; C—Flower head; D—Single floret; E—Achene ("seed").
(From a pen-drawing by C. A. Gardner, Government Botanist).

comparatively slow there is every possibility that the plant could become really aggressive on the better soil types. We have a number of examples of weeds which have remained more or less static for many years and then spread very rapidly in a short period. St. John's Wort is one and Berkheya thistle may have a similar capacity.

The assumption that it would not necessarily remain restricted to the coastal sand is supported by the fact that in South Africa it has been recorded from inland localities as well as the sea board. As with a number of other South African plants which have become weeds of consequence in Australia, Berkheya thistle has not proved troublesome in its native country.

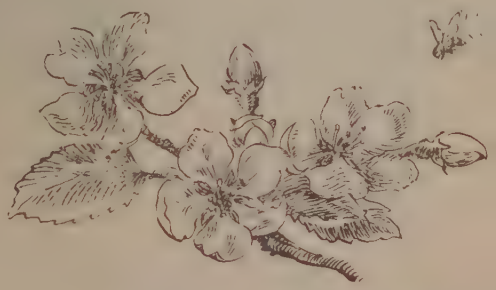
Besides its potential significance to agriculture, Berkheya thistle has proved a source of annoyance to campers attracted by the fishing possibilities of Hamelin Bay. The spines are disconcerting to even well-seasoned bare feet and can be very disturbing if they penetrate blankets.

CONTROL

It is likely that Berkheya thistle could be controlled by repeated cultivation but this is not practicable at Hamelin Bay where the weed occurs mainly among scrub on steeply undulating country consisting of loose sand in many places. Owing to the spiny nature of the plants, little control can be expected from grazing by stock.

In 1941 and 1942 experimental work was carried out with various chemicals including common salt, Atlacide (sodium chlorate) and sodium arsenite. Although the salt (2½ tons per acre) was not effective, satisfactory results were obtained with 7½ per cent. sodium arsenite and 7½ per cent. Atlacide when applied as a fine spray at the rate of 200 gallons per acre. For several years Atlacide was used to confine the weed to the main infested areas.

Trials undertaken more recently with hormone-like herbicides showed that 2,4-D ester applied at the rate of 2 lb. acid equivalent per acre was effective. A control programme using this treatment was commenced at Hamelin Bay in 1953. Spraying was made difficult by the hilly nature of the country and the fact that in many places the weed was growing among dense undergrowth. A four-wheel drive vehicle used to transport equipment, enabled most of the spraying to be done with hand leads from a power unit. Knapsack pumps were used for the remainder. Good results have been obtained and there has been little recovery from parent plants. Further sprayings have been necessary to cope with seedlings and, no doubt, owing to the presence of large numbers of dormant seeds in the soil, vigilance will be necessary for a number of years.



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A group of students at the farmers' winter course take time off to smile for the camera-man, during a talk on fat lamb production.

FARMERS RETURN TO SCHOOL

Successful Winter Course at Muresk

FORTY-TWO farmers and potential farmers from many widely-separated centres attended a three-day course in sheep husbandry at Muresk Agricultural Colleg during July. A series of lectures, film evenings and practical demonstrations by mem bers of the college staff and officers of the Department of Agriculture proved both enjoyable and instructive.

In welcoming the students at the official opening of the course, the Principal of Muresk (Mr. W. Southern), said that work would commence at 8.15 a.m. each day with a lecture in the main hall. Practical demonstrations in the shearing sheds and yards would follow, and the afternoon sessions would also commence with lectures.

Each evening, films would be shown at 7 p.m. and these would be followed by "question time" during which students were encouraged to seek information from a "brains trust" of instructors.

The Assistant Principal of Muresk (Mr. A. J. T. Marshall), lectured on sheep feeding and management, wool production and recent research work.

Interesting talks on sheep diseases were given by a Department of Agriculture Veterinary Surgeon, (Mr. J. Craig), and the subject of blowfly control was effec tively handled by Mr M. Butler, Shee and Wool Instructor, Department of Agri culture, who also demonstrated how t care for the shearing plant and how t perform the Mules operation.

Instruction in shearing, crutching, an farm butchering was given by the Colleg sheep husbandry instructor (Mr. H. P Dwyer), and the Muresk farm manage (Mr. D. R. Bateman), demonstrated lam marking, inoculation and the "mouthing of sheep for age determination.

The complete handling of wool in th shearing shed and the culling of Merin sheep were two subjects handled by Mr J. Reilly, another Sheep and Wool In structor from the Department of Agricul ture.

The Officer-in-Charge of Meat Produc tion (Mr. N. Davenport) used pens con-

ining Border Leicester, English Leicester, heviot, Southdown and Ryeland sheep to lustrate his talks on the British breeds sed in fat lamb production.

Following is a list of the students who ttended the Course:—

A. Tonkin (Chittering), W. R. Fiegert Carmel), W. A. N. Hodgen (Carmel), R. obartson (Carmel), W. Dermer (Fremantle), D. Reinke (Kojonup), O. E. Parkin (Naremeen), H. Brockway (Wagin), J. Harper (Ginin), J. H. Smith (Koorda), A. J. Sexton Melville), E. Chapman (N. Dinninup), T. hapman (N. Dinninup), J. A. Plant (Dinnup), J. I. Plant (Dinninup), N. Smith Arthur River), R. A. Grant (Como), R. H. awes (Kulin), M. J. Davies (Mt. Yokine), J. B. icholls (Corrigin), J. W. Wallace, (Wagin) . E. Hedley (Badgebup), A. Ladyman (Katanng), D. E. Stanley (Kalannie), R. G. Wakelam W. Perth), W. G. Wakelam (W. Perth), D. V. ott (Katanning), A. Newton (Wongan Hills), W. Goyder (Northam), D. T. Jones (Kwolyin), Halbert (Cunderdin), H. G. Clements (Basndean), D. Cooper (Carnamah), W. E. Dixon Albany), K. R. Fouracres (Manjimup), W. E. enwood (Manjimup), E. G. Stephenson (Manmup), T. G. Pearse (Wundowie), M. Anspach New Norcia), M. J. Wright (Dalkeith), D. K. ray (Bellevue), A. Hornsby (E. Wagin).

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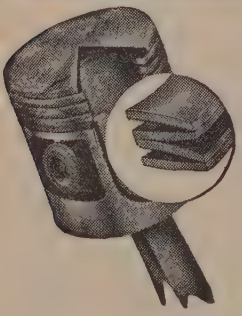

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Fig. 1.—Concrete-lined main supply channel

IRRIGATION IN WESTERN AUSTRALIA

Report on Government-Controlled Schemes 1954-1955

By H. K. GIBSONE, Officer-in-Charge, Irrigation

THE 1954-55 season showed a further increase of 2,790 acres in the land under irrigation in the Harvey, Collie and Waroona areas. Of the present total of 25,342 acres irrigated in these districts, 16,426 acres are under permanent pasture and over 92% of the area is used for dairying and fat stock production.

Brief reports of progress in the three irrigation areas are given hereunder.

HARVEY IRRIGATION AREA

The total area irrigated was 12,033 acres, an increase of 1,440 acres on last year. The acre waterings for the season were 60,138 an increase of 6,945. The average number of waterings per acre was 5.0 compared with 5.02 for last year.

The area of irrigated pasture increased by 1,077 acres to 8,736 acres and the average number of waterings given to irrigated pasture was 6.98.

Since the construction of Stirling dam this area has shown a steady increase each year and by next summer the area irrigated should be nearly up to the capacity of the dams.

Last year Stirling dam did not fill but the position was saved by heavy rains in February.

HARVEY (CENTRE OF IRRIGATION AREAS) RAINFALL.

	1953 Points.	1954 Points.	1955 Points.
January	2	35	23
February	149	3	812
March	9	28	1
April	55	164	271
May	641	691	565
June	1,074	411	476
July	612	878	784
August	252	403	1,315
September	266	192	533
October	509	181	482
November	173	200	43
December	5	50	128
Total	3,549	4,011	3,747

	Points.
Harvey (Centre of Area), Annual Average	4,014
Brunswick (South of Harvey), Annual Average	4,112
Waroona (North of Harvey), Annual Average	4,109
Pinjarra	3,784

COLLIE IRRIGATION AREA

The area irrigated was 9,430 acres, an increase of 367 on the previous season. The acre waterings were 48,194 an increase of 3,820. The average number of waterings per acre were 5.11 compared with 4.90 last year. Irrigated pasture increased by 168 acres of 5,769 the average number of

1953 54 AND 1954-55 IRRIGATION WATER UTILIZATION FIGURES.

District.	Permanent Pasture.		Dry Land for Early Winter Feed.		Fodder.		Potatoes.		Vegetables.		Pumpkins.		Orchards and Vines.		Softening.		Total Acres.	
	1953 54.	1954-55.	1953 54.	1954-55.	1953-54.	1954-55.	1953-54.	1954-55.	1953 54.	1954-55.	1953 54.	1954-55.	1953 54.	1954-55.	1953-54.	1954-55.	1953 54.	1954-55
Collie	5,601	5,769	2,540	2,727	316	341	323	245	108	131	47	82	13	14	115	121	9,063	9,430
Harvey	7,659	8,736	1,604	2,185	425	393	458	257	136	151	76	95	235	216	....	....	10,593	12,033
Waroona	2,132	1,921	....	1,092	184	192	225	155	83	231	269	288	3	....	....	....	2,896	3,879
Total, All Districts	15,392	16,426	4,144	6,004	925	926	1,006	657	327	513	392	465	251	230	115	121	22,552	25,342
Percentage of Land Irrigated	68·23	64·82	18·38	23·69	4·10	3·65	4·45	2·59	1·45	2·02	1·74	1·83	1·11	0·91	0·51	0·48	99·98	99·99
Acre Waterings	90,312	101.462	8,333	11,197	3,435	3,268	4,405	2,363	1,492	1,745	1,507	1,549	1,072	845	115	121	110,671	122,550
Average Number of Waterings	3·87	6·18	2·01	1·86	3·71	3·53	4·38	3·60	4·56	3·40	3·84	3·33	4·27	3·67	1·00	1·00	4·91	4·84
Percentage of Water used	81·60	82·76	7·53	9·15	3·10	2·67	3·98	1·93	1·35	1·42	1·36	1·26	0·97	·69	0·1	0·1	99·99	99·97

Permanent Pastures—Consist of perennial species such as paspalum, perennial ryegrass, cocksfoot, etc., in association with white clover and occasionally strawberry clover.

Early Winter Feed—Watering of dryland for early germination of annual pastures, consisting of Subterranean clover, annual ryegrass and minor clover and grasses.

Fodders—Consist of maize, millets, sorghum and sudan grass chiefly.

Land actually graded 1953–54 season 964 acres Government Power Graders + 947 acres by farmers and contractors = 1,911 acres.

Land actually graded 1954–55 season 1,056 acres Government Power Graders + 685 acres by farmers and contractors = 1,741 acres.

Drains, channels, etc., excavated 1953–54, 1,588 chains ; 1954 55, 1,602 chains.

Cost of Waterings.—Basic rate. £1 2s. 6d. per acre. This sum allows two waterings and is a compulsory charge on all irrigated land within the scheme area. All further waterings cost 3s. 9d per acre. To water one acre of permanent pasture costs approximately £1 17s. 6d.

Fig. 2.—Concrete-lined supply channel showing wooden drop and check

waterings for irrigated pastures being 6.84 compared with 6.58 the previous season.

Due to the February rains and also the fact that it was essential for the Wellington dam to be empty by the end of the season to enable structural alterations to be commenced there was no shortage of water in the Collie area. This accounts for the slight increase in the area and the rather high number of waterings for irrigated pastures.

Further expansion and increased production will be affected when storage is increased by the raising of the weir wall some 50 feet.

WAROONA IRRIGATION AREA

The area irrigated was 3,879 acres, an increase of 983 acres on the previous season. The acre waterings were 14,218 an increase of 1,104. The average number of waterings per acre was 3.66 compared with 4.53 for the previous season.

The area of irrigated pasture decreased from 2,132 acres to 1,921 acres. The average number of waterings for permanent pasture was 4.5 compared with 4.54 for the previous season.

The sudden increase in the area irrigated was largely due to the February rains which caused a very early germination of subclover. Irrigation was then used to keep this clover growing until the winter rains. This early clover watering also reflects in the rather low figure of 3.66 for the number of waterings per acre.

WATER UTILISATION

The attached table shows that the total area irrigated in the three irrigation districts was 25,342 acres an increase of 2,790 acres, and that acre waterings were 122,550 an increase of 11,879. The average number of waterings per acre was 4.84 compared with 4.91 for the previous year. This decrease is due to the increase in the number of early clover waterings from 4.144 to 6.004 acres.

Of the total area irrigated 25,342 acres, 64.82 per cent. was used for permanent pastures and a total of 92.16 per cent. for dairying and fat stock purposes. Of the water used, 94.57 per cent. was used for the above purposes.

It is evident that pasture production in all its forms—permanent pasture, early clover and fodder crops—is the main feature of both the utilisation of the land and water in the irrigation areas.

LAND GRADING

During 1954-55 a total of 1,741 acres of land were graded as compared with 1,911 for the previous year.

Of this total, Government machines handled 1,056 acres on 105 farms at an average cost of 7 10s. 5d. per acre. The farmers were again charged £4 per hour for use of the machines for grading and

IRRIGATION RESERVOIRS.

District.	Reservoir.	Type.	Depth of Water.	Capacity.	Acres.	Crest Length.	Area of District.	Ultimate Rateable Area.
			Feet.	Gallons.	Feet.	Feet.	Acres.	Acres.
Harvey	Harvey	Concrete	60	2,250,000,000	8,300	797	2,928	2,928
	Stirling	Earth Fill	150	12,000,000,000	44,344	900	29,735	10,077
Waroona ..	Drakesbrook ..	Earth Fill .	54	504,000,000	1,855	580	10,325	3,441
	Sampson	Earth Fill	100	1,800,000,000	6,540	800		
Collie	Wellington	Concrete	65	8,700,000,000	31,500	1,200	28,762	9,288
			....	25,254,000,000	92,539	....	71,750	25,734

£5 2s. 6d. per hour for other work. The average time to grade 1 acre was 1.88 hours.

The utilisation of land immediately after grading is of interest as shown in the following table.

USE OF LAND IMMEDIATELY AFTER GRADING.

	Acres.
Vegetables	48
Potatoes	188
Fodder crops	441
Annual pasture	77
Permanent pasture	789
Fallow	198
	1,741

Since the 1949-50 season, Government power graders have graded 4,729 acres and contractors and farmers 3,069 making a total of 7,798 acres. During this period 132 miles of farm drains have been constructed at an approximate cost of 4s. 4d. per chain.

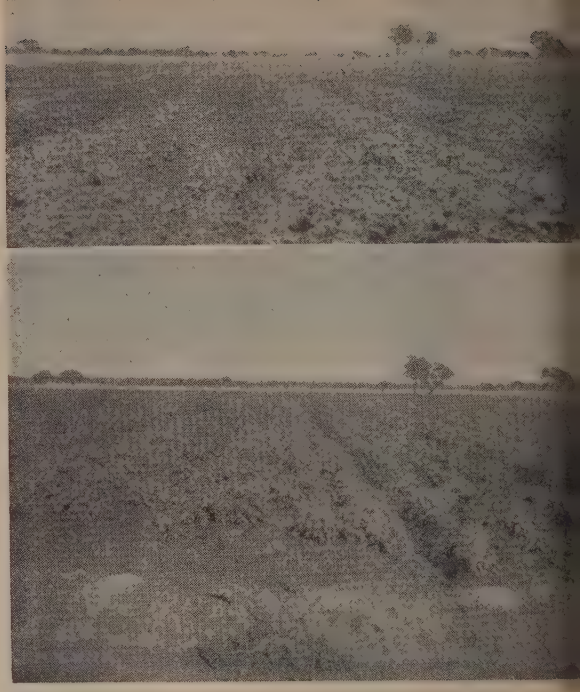
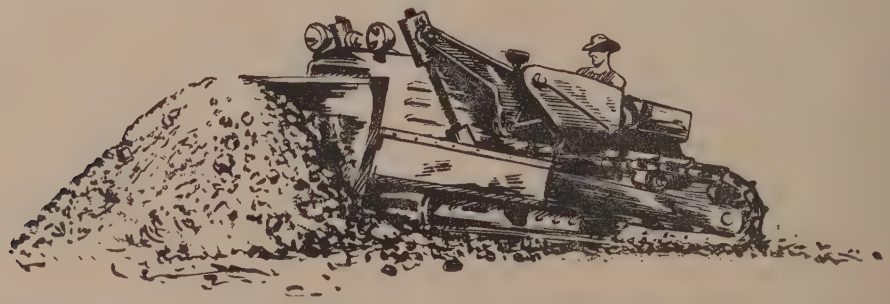


Fig. 3.—(Above) Final preparation of land sown to potatoes for furrow method of irrigation. (Below) Some weeks later showing four rows of potatoes to each land with irrigation furrows on each side

The value of these drains can be appreciated when it is realised that we are irrigating in a 40in. rainfall. Of this 40in. rainfall an average of 33in. normally occurs during the months: May-September inclusive. On occasions as much as 20in. has fallen during the month of June with the annual aggregate as high as 60in. Therefore, it can be readily seen how necessary adequate drainage is if waterlogging and/or flooding of land is not to occur.



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INSECT Pests AND THEIR CONTROL

By C. F. H. JENKINS, M.A ., Government Entomologist

COCKROACHES AND THEIR CONTROL

SEVERAL species of cockroaches are now general household pests. In this country some of the native varieties have become semi-domesticated and, in addition, two or three introduced forms are quite common.

The large reddish-brown winged American cockroach (*Periplaneta americana* L.) is probably the most plentiful. It measures about 1½in. in length and is the largest domestic roach found in this State. Another common species is the much smaller German roach (*Blatella germanica* (L)), brownish in colour and characterised by the two black stripes on the thorax.

Cockroaches are practically omnivorous but are particularly fond of foodstuffs favoured by man. On this account the insects frequently assume plague proportions in kitchens and galleys.

ERRATA

In the May-June issue, page 342, the illustration (Fig. 2) was incorrectly captioned. It should read as follows:—

Fig. 2.—1 and 2, Side and end views of larva of tomato fly (Lonchea splendida); 3 and 4, Side and end views of larva of Mediterranean fruit fly (Ceratitis capitata); 5, Pupa of Mediterranean fruit fly; 6, Larva of ferment fly (Drosophila sp.).

LIFE HISTORY

The eggs of the cockroach are developed in a chitinous capsule or case which is carried for a time protruding from the abdomen of the female. These capsules may be found attached to rafters, books, boxes, or other rough surfaces. In the case of the American cockroach, attempts may be made to cover the egg capsules with bits of chewed paper, etc.

The young, on hatching, have the general form of the adult. They moult several times and reach maturity after a period of some months.

The exact duration of the different stages varies considerably. For the egg stage 70 days at 77 deg. F. has been

Fig. 1.—The American cockroach. (U.S. Dept. Agric.)

Fig. 2.—The German cockroach: a-d, Immature specimens; e, Male; f, Female with egg case; g, Egg case enlarged.
(U.S. Dept. Agric.)

quoted as the developmental period, but under Australian summer conditions this time is probably reduced. Several months or perhaps a year may elapse before maturity is reached and the longevity of the adults is considerable. An individual under observation in the Entomological Laboratory survived for over two years. The females may lay a number of capsules, each containing approximately 16 eggs so that the rapidity with which cockroach plagues sometimes develop can easily be explained.

RELATIONSHIP TO DISEASE

On account of its association with offal and scraps of all kinds the cockroach is a potential mechanical carrier of disease. Roaches have been known to eat infected excrement and disgorge infective material some time later, but actually the roach does not compare with the house fly as a menace to public health.

CONTROL

Meticulous care with regard to the disposal of foodstuffs and scraps is the first essential in any attempt to control this pest.

Sprays.

The use of kerosene-pyrethrum or DDT fly sprays, where direct contact can be obtained, is effective, but on account of the insect's nocturnal and retiring habits many are able to survive such treatments. Liquids containing a relatively high proportion of the so-called residual insecticides such as DDT, Lindane, BHC, chlordane and dieldrin, however, will leave residues toxic to the roaches for a long period. These materials should be applied to skirting boards, behind cupboards and into cracks and crevices likely to harbour cockroaches. None of these chemicals should be allowed to contaminate foodstuffs or cooking utensils, and chlordane and dieldrin in particular are best applied with a brush indoors to eliminate the chance of spray drift.

For residual effect, DDT is recommended at four or five per cent., chlordane at two per cent. and dieldrin at ½ per cent.

It should be noted that some insecticide formulations may leave stains, especially when made up as water emulsions, and this possibility should be remembered when treatments are being applied.

Dusts.

Toxic dusts applied to cracks and crevices and sprinkled into other situations favoured by cockroaches will give good control. Useful powders are 10 per cent. BHC and DDT. Sodium fluoride was extensively used before the development of the newer insecticides, and borax was also popular. Borax is only a weak insecticide, however, and may not prove effective in controlling a bad cockroach infestation. Particular care should be taken to see that foodstuffs are not contaminated with either sodium fluoride, DDT or BHC.

Fumigants and Insecticidal Smokes.

In the case of very severe infestations, fumigation with cyanide may be desirable, but under such circumstances the services of a professional fumigator should be obtained.

Insecticidal smoke bombs containing BHC and lindane and lacking the musty odour of earlier types are now procurable, These may be used effectively in some situations and should be used in accordance with the directions given by the manufacturers.

Traps and Baits.

A cockroach trap has proved most effective in catching large quantities of cockroaches for laboratory purposes and

should be useful in any infested premises. The trap may be made from a suitably-sized tin with a flanged edge, such as is found in press-top treacle tins. The flange enables a small quantity of liquid bait to be retained when the tin is laid in position on its side. A tapering cone of fly-wire is fitted into the tin and a flattened hole about $\frac{3}{8}$in. broad and $\frac{3}{8}$in. high is made in the apex of the cone to give the insects free entry. The cone may be held in position by allowing the gauze at the base to fold over on to the outside of the tin, where it may be secured by a piece of thin wire.

A neater article may be achieved by cutting almost the entire centre out of the press-top lid and soldering the cone into position. This will enable the trap to be easily dismantled for emptying and cleaning.

One of the most attractive materials for cockroaches is stale beer, and traps should be baited with a few drops of this liquid before being placed on their sides behind stoves, in cupboards, or in other likely situations. The best results so far obtained have followed the use of stale beer, but if this is not available moist apple peelings or water sweetened with treacle or a few food scraps may be tried.

Traps should not be cleaned or washed with strong disinfectant materials as the smell may act as a repellent to the cockroaches, and reduce the efficiency of the trap.

SCHOOLS OF AGRICULTURE—NARROGIN, DENMARK AND HARVEY

Applications are now being invited for the two years' vocational course at the Schools of Agriculture commencing in February, 1957.

Applicants must be between the ages of 14 and 17 years and must have passed the Sixth Standard of the Primary school curriculum.

Applications must be made on the prescribed forms obtainable on request from the Education Department, Perth, and must be lodged prior to the 1st November, 1956.

The schools provide for post primary work and also practical and theoretical instruction in the following subjects:—

Agriculture, Veterinary Science, Farmwork, Blacksmithing, Tinsmithing, Carpentry, Building Construction, Dairying, Bacon Curing, Slaughtering, Gardening, Poultry Raising, Pig Raising, Shearing, Woolclassing, Farm Bookkeeping, etc.

In addition the course is extended to include the following subjects:—

At Narrogin.—Leathercraft, Fruit Drying, Orchard Work and Wheat Growing.
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Further particulars may be obtained from the Education Department, Perth.

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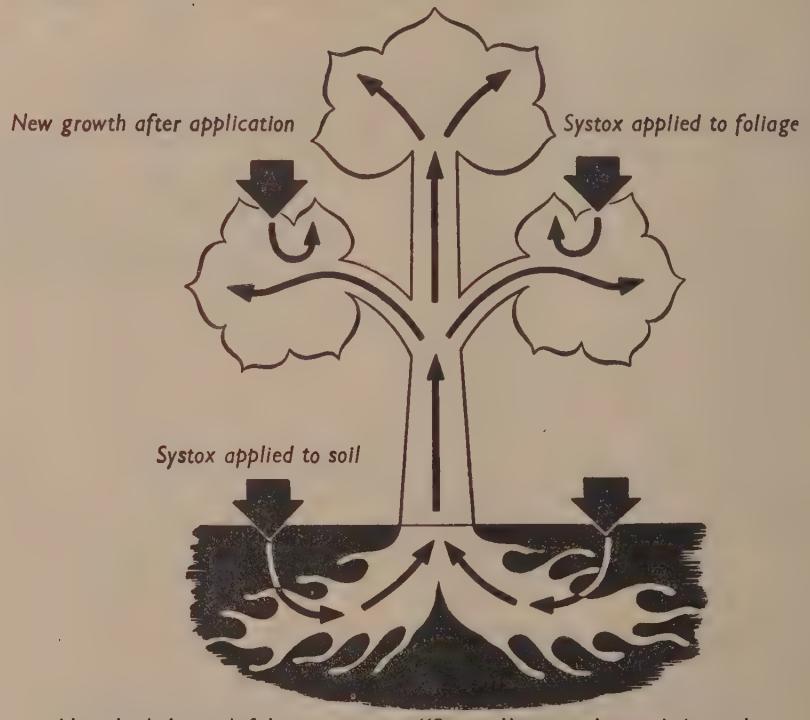

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THE FLOUR QUALITY OF EARLY MATURING WHEAT VARIETIES

By W. P. CULLINANE, B.Sc. (Agric.), Adviser, and J. REEVES, B.Sc. (Agric.), Plant Geneticist

THE present abundance of wheat on exporting markets has made importers very selective in choosing wheats to fulfil their requirements. Where these wheats are required for breadmaking and the wheats are otherwise sound, flour quality, i.e., protein content and strength becomes the main criterion, both as to price and even the desire to purchase. Many of the importing countries are able to produce varying amounts of wheat, but the protein content and baking strength are low, so that to raise their flour grists to a satisfactory level they require wheats which are high in these qualities.

At the end of each season, grain samples from the wheat variety trials on research stations are forwarded to the Cereal Research Laboratory, Perth, for grain and flour quality tests to determine their relative merits under the particular growing conditions at the various stations.

For the 1954/55 season in order to subject these tests to statistical analysis, samples were collected from each of the replicated plots in the early maturing variety trials at the Avondale, Chapman and Merredin Research Stations. By analysing each of the tests it is possible to obtain the differences necessary for significance and in this manner determine whether any particular variety is significantly higher in quality than any other variety under the conditions of that particular trial.

Yield and certain other characteristies of these early maturing varieties were discussed in a previous article in this Journal (1). The yields are included again in Table 1 as they are used in the calculations of pounds protein per acre.

Of the varieties under test, five are named varieties and four are cross-breds produced at the Merredin Research Station.

The varieties are:—

Bungulla.
Insignia 49.
Gabo.
Saga.
Wongoondy.
M.115—Eureka 2 X M60 (Sword X Kenya C.6041).
M.116—Charter X (Bungulla) 2.
M.117—Charter X (Bungulla) 2.
M.118—Charter X (Bungulla) 2.

Short descriptions of the cross-breds have been published previously (1), (2).

DESCRIPTIONS OF TESTS CARRIED OUT

When information is required concerning the desirability of a wheat for inclusion in a grist for the production of flour for breadmaking, almost the first consideration is its protein content. Protein is a complex substance containing nitrogen and in the case of non-leguminous plants, such as the cereals, the amount of protein produced by the plant will be limited by the amount of nitrogen available from the soil.

The amount of nitrogen in protein from a particular source varies only slightly and this feature is the basis of protein determination. The estimation of the amount of nitrogen in cereals can be made with

considerable accuracy and this figure multiplied by an accepted factor (5.7 in the case of wheat) is the recognised protein content of the grain.

The protein in flour is extremely important in breadmaking. When wheat flour is mixed with water it is the protein in it which produces that characteristic substance gluten. This gluten is the basis of that viscid network in the dough which retains the gases during pannary fermentation and thus enables the production in the bakehouse of large, light loaves of nutritious bread.

High quality bread does not wholly depend on the amount of protein in the flour. The quality of the gluten produced from this protein when it is made into dough is extremely important; in fact when the protein percentage rises above 9-10 per cent. (equal to 10-11 per cent. in the grain) it becomes the more important factor. The tests enumerated in this article for the determination of gluten quality are the farinograph and Pelshenke tests.

The farinograph test is perhaps the most widely used test for flour quality the world over. Flour and water are mixed in the bowl of the instrument and the behaviour of this mixture under the gruelling abuse of the paddle in the bowl is recorded in the form of a graph or a farinogram. From this farinogram many characteristics of the flour may be noted. the most important perhaps being:—

(a) Water absorption or the percentage of water necessary for a flour to become a true dough—this may range from 50 per cent. for a weak flour with a low protein content to 70 per cent. for a strong flour with a high protein content.

(b) Dough development time or the length of time mixing is necessary for the development of a true dough—a flour with a medium development approaches the ideal and is a function of protein content and variety.

(c) Stability or the ability of the flour and water mixture to maintain consistency with vigorous working. This is a measure of the tolerance of a flour to withstand fermentation and thus enable good bread to be baked over a longer period of maturity or dough ripeness.

The two latter characteristics are largely combined to give the strength figure—a figure which represents the inherent baking strength of a flour and figures have been recorded in our laboratory of from under 2 minutes to over 50.

The Pelshenke or whole-meal fermentation test is based on the ability of a doughball, made from the ground grain and a yeasted solution, when placed in distilled water to withstand disintegration. The longer the time (quoted in minutes) the higher the quality of the flour that may be milled from the grain.

Thus we have two types of test:—

(a) the protein test on the grain, which is an index of the quantity of gluten which will be present in the dough;

(b) the farinograph and Pelshenke tests which though influenced by the quantity of the gluten are measures of gluten strength or quality. As these latter tests are influenced by the amount of gluten produced in the dough as well as its quality they become measures of actual baking strength.

There is a fairly close relationship between Pelshenke time and farinograph strength figure, the two measures of baking strength. However there are exceptions; at Merredin the Pelshenke time for Gabo is less, and for Wongoondy at Avondale it is more than could be expected from the respective strength figures. The farinograph figures are normally more reliable than the Pelshenke times.

The results of the tests are shown in Table 1.

VARIATION IN PROTEIN CONTENT

The range in the protein content of the samples is from 8.40 per cent. to 15.40 per cent., a difference of 7 per cent. When the differences are examined it is seen that at the low protein level of the wheats grown at Avondale there is only a difference of 0.57 per cent. between the protein content of the individual varieties, but at the higher

Table 1.

ESTS ON GRAIN AND FLOUR FROM LATE PLANTED WHEAT VARIETY TRIALS—1954-55.

Variety.	Avondale.						Chapman.						Merredin.					
	Farinograph.		Pelshenke Time.	Protein Content.	Yield (bush. per acre).	Protein per acre.	Farinograph.		Pelshenke Time.	Protein Content.	Yield (bush. per acre).	Protein per acre.	Farinograph.		Pelshenke Time.	Protein Content.	Yield (bush. per acre).	Protein per acre.
	Strength Figure.	W.A.					Strength Figure.	W.A.					Strength Figure.	W.A.				
	Min.	%	Min.	%		Lb.	Min.	%	Min.	%		Lb.	Min.	%	Min.	%		Lb.
Bungulla	4·7	56·9	49·7	8·56	22·47	115·2	7·1	61·4	71·8	14·22	16·83	143·6	5·7	57·8	46·3	11·85	18·63	125·5
Insignia 49	5·7	56·9	63·5	8·56	22·33	114·8	8·7	63·6	115·1	14·88	15·33	136·9	6·4	58·2	72·3	12·50	16·83	126·2
Wongoondy	3·8	63·7	65·2	8·40	22·67	114·4	17·6	67·9	165·2	14·74	18·00	161·0	12·9	67·0	82·0	12·20	15·92	116·4
Gabo	9·0	65·4	97·6	8·86	22·07	117·4	15·9	70·7	139·6	14·48	17·37	150·9	11·9	70·3	50·4	12·95	17·54	136·5
Saga	....	....	....	....	....	....	....	....	....	....	....	....	16·0	72·7	82·5	13·25	15·50	123·1
M. 115	10·6	55·6	106·3	8·97	20·07	108·1	16·9	64·2	143·5	15·4	15·87	149·0	14·3	58·5	92·1	13·00	13·96	108·9
M. 116	....	....	....	....	....	....	....	....	....	....	....	....	9·5	58·8	83·8	12·95	15·92	123·6
M. 117	....	....	....	....	....	....	....	....	....	....	....	....	6·2	57·6	46·8	12·00	16·42	117·9
M. 118	....	....	....	....	....	....	....	....	....	....	....	....	6·0	58·0	48·1	12·20	17·67	129·2
Difference for Significance 5% Level	0·6	1·2	7·8	0·27	1·61	N.S.	1·6	1·7	11·3	0·45	1·22	12·8	0·8	1·0	6·2	0·54	1·44	10·9
Difference for Significance 1% Level	0·8	1·6	10·8	0·37	....	....	2·1	2·3	15·6	0·62	1·69	....	1·0	1·3	8·4	0·73	1·96	14·8
Difference for Significance 0·1% Level....	....	....	14·8	0·51	....	....	2·9	....	.....	....	....	....	1·4	....	....	0·98	.....	19·8

W.A. is water absorption on a 13·5% moisture basis. N.S.—Not Significant.

levels at Chapman and Merredin the differences are 1.18 per cent. and 1.40 per cent. respectively. However the difference between the average protein at Avondale, and at Chapman and Merredin respectively was 5.87 per cent. and 3.83 per cent. This confirms previous tests which show that, under our conditions, climate and soil fertility have more effect on protein content than variety.

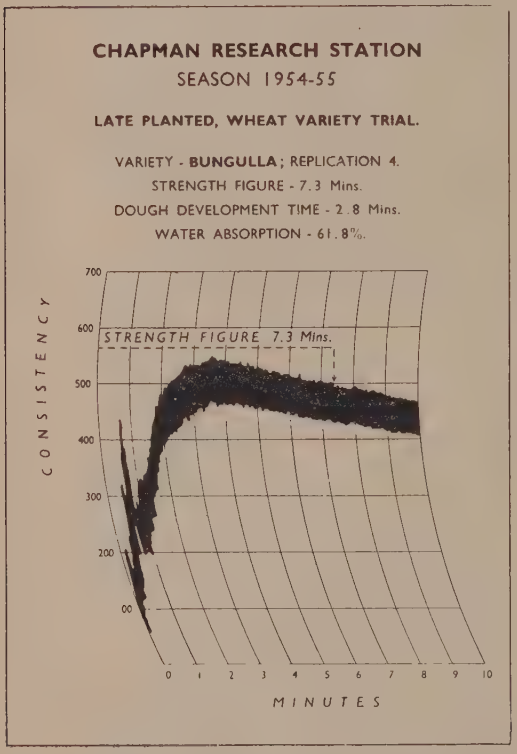

Fig. 1.—The strength figure of 7.3 minutes for Bungulla indicates that this variety has produced a flour of only moderate baking strength, even though the protein content is high

PROTEIN PER ACRE

Of the five varieties planted at all three stations, M.115 had the highest protein, though this was not significantly higher than Gabo at Avondale or Merredin. It however gave significantly lower yield per acre than the other four varieties at both Avondale and Merredin. At Chapman, Gabo and Wongoondy significantly outyielded it and in only one instance, was its yield higher than another variety and then not significantly so. The other variety was Insignia 49 at Chapman.

It is possible to produce wheats whose protein content is higher than that of the ordinary varieties, but these are often low yielding; the cross-bred M.115 may be taken as an example of this. But yield is also important to the farmer as it is largely the factor on which financial returns depend, and thus not so much as a compromise but as a measure of greatest returns, the concept of protein per acre is being increasingly studied. Yield has always been important, while protein content has long been recognised as one of the necessary corollaries for a good bread wheat, so that this concept, unconsciously perhaps, has long been in evidence.

Millington (4) has discussed this matter and suggested that there is a tendency for a variety which produces grain with a higher protein content to be lower yielding. He also showed that when seasonal influences favour high protein content the yields tend to be lower. At Chapman in 1954 Gabo significantly outyielded Insignia 49, but the protein content of Insignia 49 was higher than Gabo; these results were a reversal of those of the season 1953.

The average protein per acre of the five varieties grown at the three research stations were:—

	lb.
Gabo	134.9
Wongoondy	130.6
Bungulla	128.1
Insignia 49	126.0
M.115	122.0

Gabo has thus returned the highest average yield of protein per acre, but it was out-yielded at Chapman by Wongoondy (though not significantly) and only Insignia 49 was significantly lower at this station. At Merredin it had the highest protein per acre yield of the nine varieties, and was significantly higher at the 5 per cent. level than the four varieties, Bungulla, Wongoondy, M.117 and M.118. The results at Avondale showed only slight differences and these were not significant. Thus, though it appears probable that Gabo on the average will yield more protein per acre than the three varieties, Bungulla, Insignia 49 and M.115, the results of this series of tests are inconclusive. It is hoped to carry out further

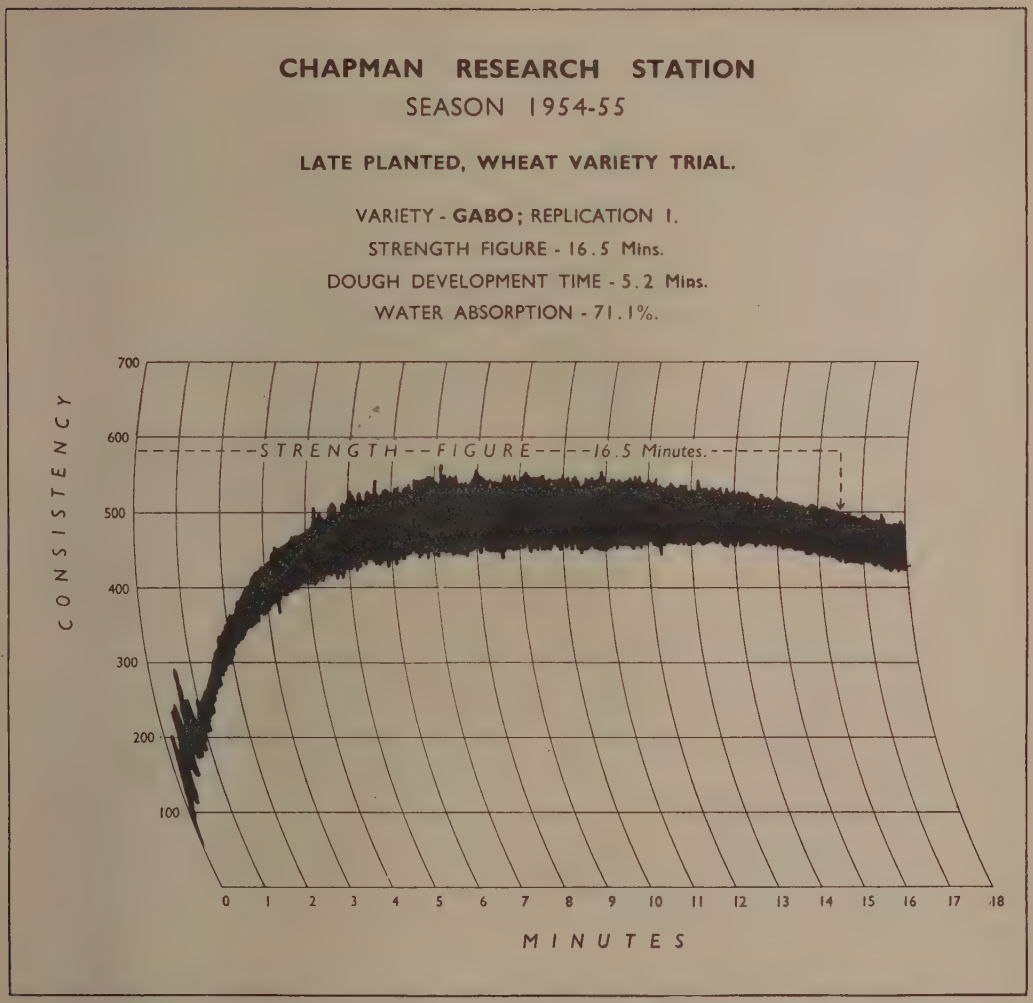

Fig. 2.—Grown under identical conditions to Bungulla in Fig. 1, Gabo has produced a strength figure of 16.5 minutes. The "premium" flour from this variety would be of excellent baking strength

work on this subject, in an effort to determine whether the higher quality varieties, such as Gabo, do produce significantly more protein per acre than weaker varieties.

PROTEIN CONTENT

The crossbred M.115 gave the highest grain protein of the five varieties on all three research stations and of the other four varieties planted at Merredin, only Saga was superior. Under nearly all circumstances therefore, the grain from this crosssbred may be expected to be comparatively high in protein.

The mean of the other four varietes planted at all three stations was:—

	%
Gabo	12.10
Insignia 49	11.98
Wongoondy	11.78
Bungulla	11.54

Gabo also registered the highest figures for these four varieties at each station, except at Chapman where both Insignia 49 and Wongoondy were superior, though not significantly so. However in all trials it was superior to Bungulla (though not significantly at Chapman).

As the data is only for a single season some caution must be expressed in reaching a conclusion, but it appears that the average protein content of Gabo is probably higher than that of the other three varieties and is higher than Bungulla.

PROTEIN QUALITY AND BAKING STRENGTH

As mentioned previously there is a fairly close relationship between Pelshenke time and farinograph strength figure. As the farinograph strength figure is normally the more reliable index of protein quality and baking strength, it is this measure which is considered in this discussion.

Accepting the Merredin tests as a standard and a strength figure of 10 minutes as the division between weak and medium strength varieties, the wheats may be divided into two groups, as follows:—

Weak varieties—Bungulla, Insignia 49, M.117 and M. 118.

Medium-strong varieties — Gabo, Saga, Wongoondy and M.115.

In addition M.116 is almost of medium strength and could be rated as belonging to the lower ranges of the medium-strong group.

Reference to Table 1 will show that as the protein content increases so does the strength figure, though all varieties do not react in the same way, and the increment for each unit of protein increase is not the same for each variety. The rate of increase for Gabo and M.115 is greater than for Insignia 49 and Bungulla, while the rate of increase for Wongoondy is much greater still, as Wongoondy has the lowest strength figure under the low protein range at Avondale and the highest figure of the series under the high range at Chapman. Thus no advantage will be gained by sowing Wongoondy in preference to the low strength varieties Bungulla and Insignia 49, when the protein content of the crop may be expected to be low. However where a moderate to high protein may be expected i.e. on medium to high fertility soils Wongoondy will produce grain of good strength.

This rate of increase is low in the case of Insignia 49 and Bungulla and no matter how high the protein, they will never produce really strong grain, though Insignia 49 at the same protein level, will be stronger than Bungulla.

Gabo and M.115 show a high increase of strength with increasing protein content, with the advantage that even at low protein levels they have a reasonable strength. However to produce a good loaf of bread a flour should have at least 9 per cent. of protein (equivalent to a grain protein of 10 per cent.). Wheats with comparatively high strength and low protein content will be more useful in blending with low strength wheats of high protein content than by using directly for breadmaking.

WATER ABSORPTION

Water absorption is often included in strength definitions by leading authorities. The amount of water a flour will absorb is a factor of considerable importance to the baker, enabling him to manufacture more loaves from the same quantity of flour.

Water absorption is a function of variety and protein content. The wheats under review fall into two groups, those with a high absorption, Gabo, Saga and Wongoondy, and the remainder with a low to medium absorption. As the protein increases the water absorption also increases. Millington (4) has calculated this increase for Gabo and Insignia 49, two varieties that may be taken as representative of the above groups, at approximately 1 per cent. for each 1 per cent. increase of dry gluten* for Gabo and ¾ per cent. for each 1 per cent. increase for Insignia 49. He also calculated that at the 10 per cent. dry gluten level the water absorption of Gabo would be almost 6 per cent. higher than of Insignia 49. Owing to the generally higher water absorption of the higher baking quality varieties and the tendency for them to have higher protein contents, more loaves of more nutritious bread can be made from a ton of Gabo flour than from a ton of Insignia 49 flour. As Millington (4) has pointed out, this in certain instances would enable a premium of tenpence a bushel to be paid with no increase or even a decrease in the flour costs for each loaf of bread.

* Approximately a 1% increase in wheat protein will give 1% increase in dry gluten.

CONCLUSION

Wheat varieties are classified according to their flour quality into three groups, weak, medium-strong and strong. Bungulla and Insignia 49 can be placed in the weak group—the above tests have shown that Insignia 49 is slightly stronger than Bungulla. Gabo and Wongoondy are of the medium-strong type, being lower in strength than such strong varieties as Pusa 4, Comeback and Festival.

These tests have shown that under adverse conditions, as during the 1954-55 season at Avondale, the stronger varieties produce flour which is not much higher in strength than that from the weaker varieties Bungulla and Insignia 49. However with better conditions and more fertile soils, the stronger varieties have the inherent capacity to produce flour which is far superior in quality for breadmaking than that from the weaker varieties grown under the same conditions.

Many of our soils even in the virgin state are of low fertility, and to maintain and raise this fertility and thus improve wheat yields and flour strength (3), increase the yields of other cereals, provide nutritious pastures for our flocks and preserve a cover of herbage for the conservation of the surface soil, it is vital that suitable rotations be practised and as far as possible leguminous pastures should be the basis of these rotations.

These tests have shown that climate and soil conditions have far more effect than variety on the protein content of the grain. They have also shown that the weaker varieties cannot produce strong grain even when grown under the most favourable conditions.

To produce stronger grain it is necessary to sow such better quality varieties as Gabo, Wongoondy (late planting) and Kondut, Javelin 48, Eureka (early planting) on soils raised in fertility to as high a level as possible.

ACKNOWLEDGMENT

The assistance received from the staff of the Government Chemical Laboratories for the protein determinations; from the Agricultural Research stations for the carrying out of the trials and the recording of yields; and from the Plant Research Division for the statistical analyses, is gratefully acknowledged.

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(3) Shier, F. L. and Cullinane, W. P.: "The Influence of Rotation on the Yield and Flour Strength of Wheat." J. Agri. W.A., 25. 2nd Series, No. 4, pp. 351-361.

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FREE SERVICE TO FARMERS

Do you know that the Department of Agriculture provides a comprehensive service of advice and technical assistance to farmers, free of charge?

When in need of advice, get in touch with your District Officer whose name and headquarters township will be found in the list of Departmental personnel on Pages 390 and 391.

These officers are there to help you and will make personal visits to your property to assist with on-the-spot advice. In addition, they will, where necessary, arrange for the services of specialist officers—all without cost to you.

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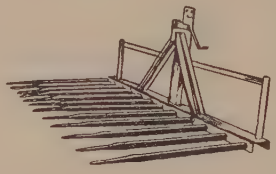

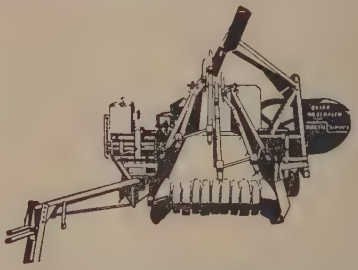

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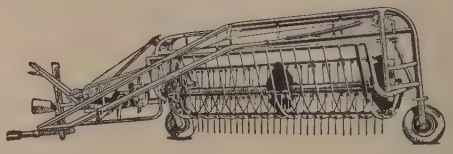

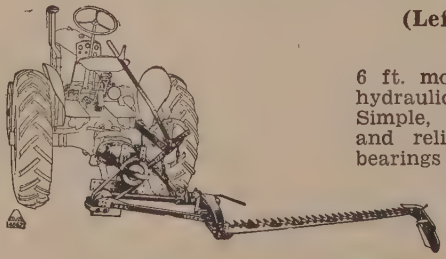

(Left) HERKULES POWER MOWER ATTACHMENT

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BEEF GROWTH RATE STUDIES

By M. CULLITY*, Superintendent of Dairying

THE Australian Agricultural Council in 1948 approved a co-ordinated plan of investigating beef growth rates in the southern regions of Australia. Considerable attention had been given to the problems of the beef industry in Northern Australia, but it was felt that the value of the southern agricultural areas as a source of fat cattle as well as for rapid and economical fattening, was not fully appreciated. The Animal Production Committee and its Technical Sub-committee on Beef Cattle were charged with the responsibility of organising, with the State Departments of Agriculture work in each of the States of New South Wales, Victoria, Tasmania, South Australia and Western Australia.

The intention was not only to gain information on growth rates in the different environments, but later when this data had been accumulated, to institute trials with various changes in management, principally supplementary feeding with a view to determining whether more economical methods of fattening could be devised. It was intended also that studies of the relationships of feeding management and breeding with carcass quality should be commenced whenever possible.

The Technical Sub-committee on Beef Cattle suggested that in order to iron out differences in seasonal conditions and so feed variations from year to year, that the preliminary data be collected in each centre for a period of five years before actual trials be instituted. However, the relatively great uniformity of seasonal conditions in this State from year to year makes this lengthy collection of data unnecessary, and therefore the preliminary period was reduced to three years.

It was hoped that this work would also contribute to a raising of interest in beef production.

The Australian Meat Board agreed to provide finance for the purchase and installation of cattle-weighing scales, and the Rural Credits Branch of the Commonwealth Bank also assisted.

This note is intended as an introduction to a series of detailed reports on the work at each of three centres selected in this State to investigate the trend and rates of cattle fattening under different environments. A report will also be submitted on the influence of calving date on growth rate.

The centres where the studies are being conducted in Western Australia are:—

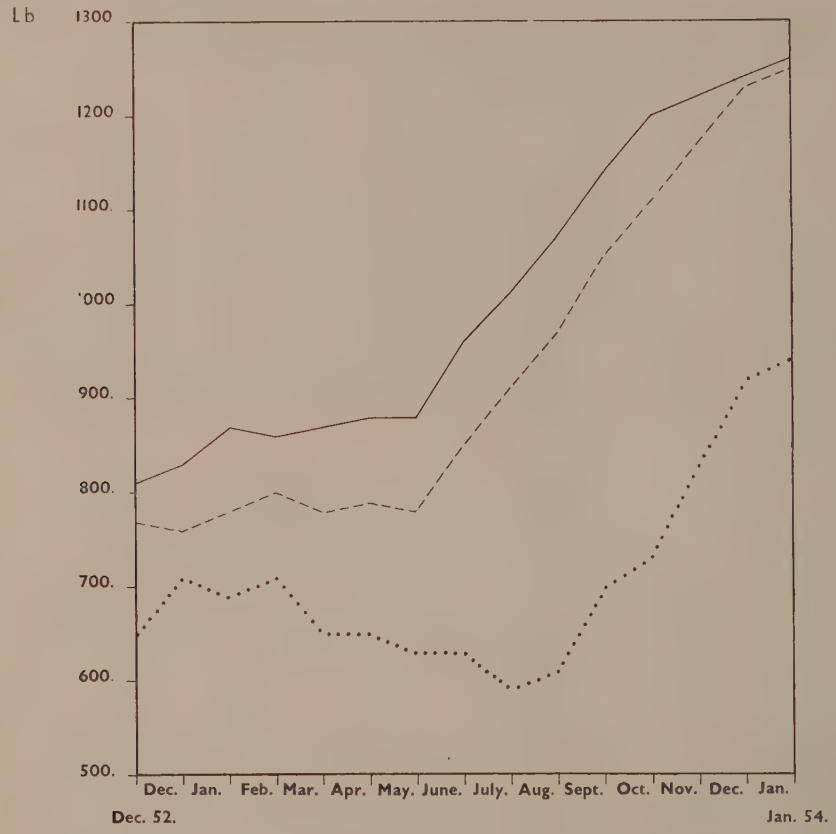
1. **Wokalup Research Station**—situated in the coastal plain 91 miles south of Perth. It has an area of 2,200 acres of which approximately 700 are under pasture. The property is suitable for dairying and fattening. Since the inception of the work, irrigation waters have become available for part of the property. The average rainfall of Harvey (4 miles distant) is 40 inches. Investigations were commenced in October, 1950. Since the summer of 1953-54, some comparisons have been made of growth rates on irrigated and unirrigated pasture.

2. **Pardalup Prison Farm**—situated 18 miles west of Mt. Barker, which is 30 miles north of Albany. The property comprises approximately 10,000 acres of which less than 1,000 have been improved. The average rainfall is 32 inches. The studies commenced in September, 1952, and so far growth trend data only has been collected.

3. **Narra Tarra**—near Geraldton, a property owned by Messrs. F. Green & Sons. It is situated 8 miles north-east

* Liaison Officer Western Australia, with Dr. M. C. Franklin, William McIlrath Fellow, who is co-ordinator on behalf of Animal Production Committee of the beef growth rate studies in the Southern States of Australia.

FIG. I. TYPICAL GROWTH CURVES AT THREE CENTRES IN WESTERN AUSTRALIA



Weighing intervals 28 days.

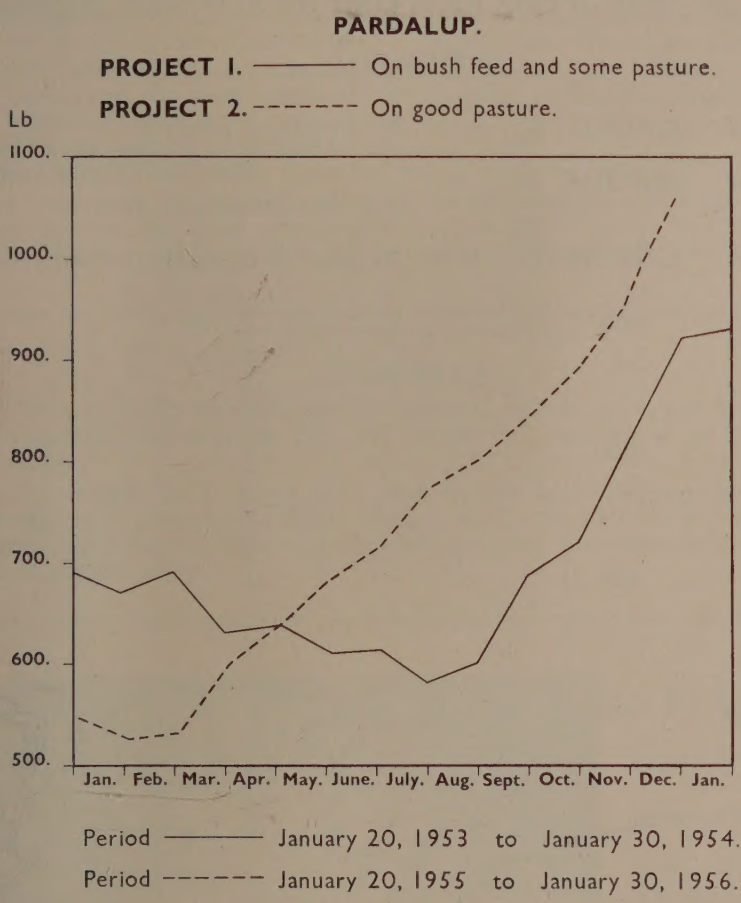
NARRATARRA	**PROJECT I.** ————	Period	December 20, 1952	to	January 15, 1954.
WOKALUP	**PROJECT 2. GROUP B.** --------	Period	December 31, 1952	to	January 27, 1954.
PARDELUP	**PROJECT I.** ·····	Period	December 24, 1952	to	January 20, 1954

of the town and is typical of a restricted area of good pasture country. On the completion of the three years' programme and the establishment of what is accepted as a normal pattern of growth for the district, it was decided to transfer the scales to another centre, and during the latter part of 1955, they were installed on the property of Mr. P. Lefroy at Cranmore Park, near Walebing, where investigations have now been commenced into the value of supplementary feeding.

GENERAL

The pattern of growth at each property has been shown to follow a regular seasonal trend (see Fig. 1). There is in each case, a distinct period of rapid gain, a static period, and in some cases a period of declining weight. The information which has been obtained will be most valuable in designing trials into methods of extending the period of seasonal growth and of lifting the rate of gain.

FIG. 2. EFFECT OF SEASON AND IMPROVEMENT IN GRAZING ON GROWTH.



For example, work has already been carried out at the Wokalup Research Station studying the use of summer-irrigated pasture in supplying high quality grazing between successive periods of annual pastures, as a means of achieving uninterrupted growth throughout the year (see Fig. 3).

The influence of having cattle on good pasture throughout the year as compared to keeping them on restricted feed can be seen clearly from Fig. 2, which shows the growth curves for groups in two years at the Pardalup Farm. The season 1955 was very good and for the first time it was possible to keep the weighing group of cattle on good pasture from early in the season, whereas in other years the stocking position on the property necessitated the use of bush paddocks for a considerable proportion of the year.

The data demonstrates that a long period of rapid growth is possible and allows consideration of the practical steps which may be taken to achieve it.

At Cranmore Park, work has been commenced in studying the influence of supplementary feeding during the summer months, in order to stimulate a greater total growth of the animals.

Work at the Centre in the future will include a study of the influence of the calving date upon weight at the optimum marketing time.

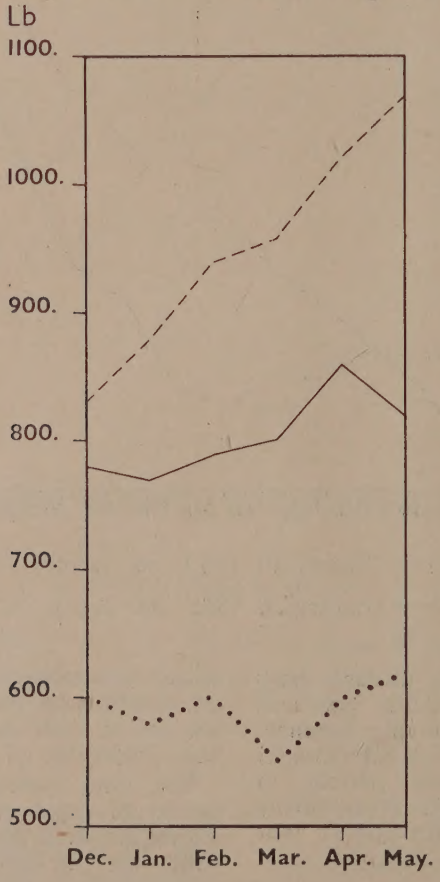
VALUE OF IRRIGATED PASTURE IN SUMMER MONTHS.

WOKALUP.

PROJECT 4 GROUP B.------ On irrigated pasture

PROJECT 4 GROUP C.——— On couch grass, unirrigated but with abnormal February rain.

PROJECT 2 GROUP F.····· On unirrigated pasture, hills and flat.



Period ------- December 16, 1954 to May 5, 1955.

Period ——— December 16, 1954 to May 5, 1955.

Period ····· December 16, 1951 to May 8, 1952.

Data on this subject has been accumulating for the cattle at the Wokalup Research Station for the past four years, and a report will be published in this series.

The studies have therefore achieved the first aim set out in the basic preschedule for this work, i.e. established acceptable growth curves as normal expectations for the various parts of the State.

It is not suggested that it has been demonstrated for the first time when cattle fatten and when they do not. Cattle raisers, from their experience, have known when their animals are fattening, when they are at maximum weights, and when best to sell. The data accumulated, however, gives a factual background to beliefs based on observation rather than measurement.

It will be of value also in providing factual data to extension officers for use in assisting farmers who are turning their attention to cattle raising.

FARMERS

This is YOUR Journal, and it has been written, edited and presented in a sincere endeavour to give you helpful information in an interesting manner.

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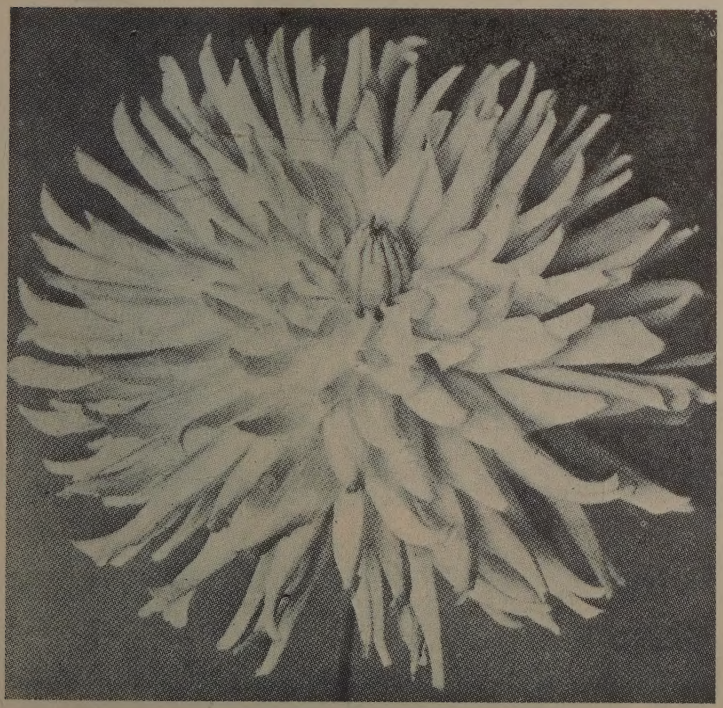

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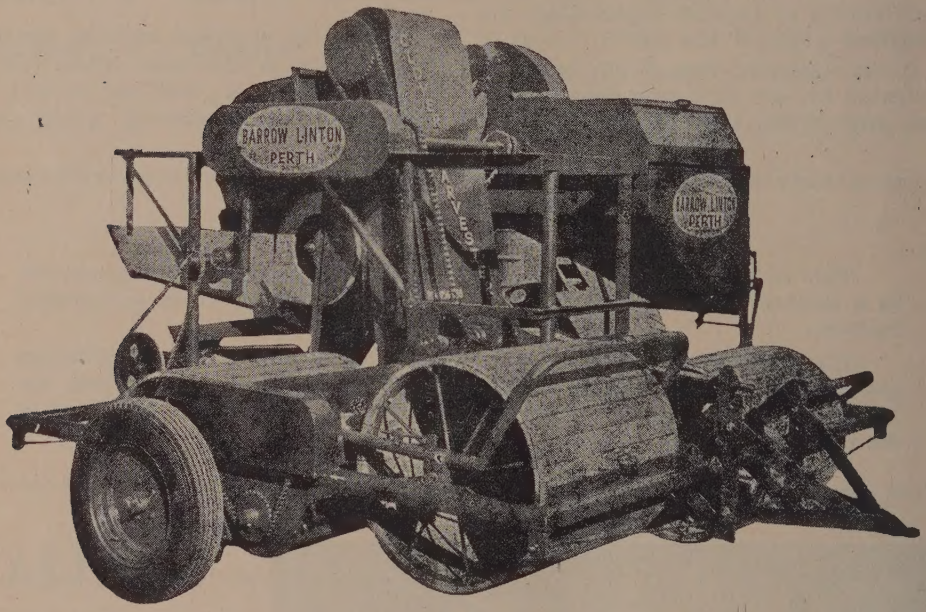

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